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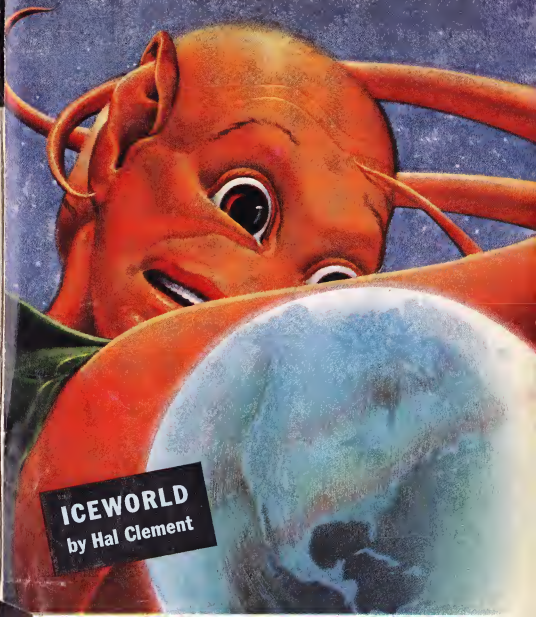
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by Hal Clement





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THE HUMAN FACTOR IN FLIGHTS BEYOND THE EARTH

edited by John P. Marbarger, Research Director, Aeromedical and Physical Environment Laboratory, College of Medicine, University of Illinois.

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EVALUATION OF DIANETICS

One year ago this writing, Dianetics was first introduced publicly; twelve months of work by many hundreds of people now make possible a first evaluation of what dianetics actually has to offer, how much validity it has, and what it actually is. It will take a century or so to determine the full and proper rating of Hubbard's work, but a first-order approximation at least can be estimated.

Briefly, dianetics itself is much less than Hubbard believed it to be—but is the essential, hitherto missing key to everything Hubbard claimed, and considerably more than he realized. In that respect, dianetics might be compared to money—"Money won't buy happiness; you can't buy everything!" is the old and very valid comment. But the other side is, "Yes—but have you tried buying them *without* money?"

Similarly, dianetics will *not* do everything, it will *not* assure happiness. But several millennia of trying to do it *without* dianetics has ade-

quately demonstrated that that system definitely does not work. Whether you call it dianetics, hoosanany, sprooplotics or anything else makes no difference; psychology—psychiatry—philosophy and religion have not produced an adequately high level of human happiness, or an adequately high level of cultural sanity.

"Man's Proud History" is a seven thousand year written record of murder, rape, war, and looting. It's a record of the wastage of the best of human achievements, the destruction of the best of human abilities, the crushing of high, fine hopes and ideals. The world, at this moment, is busily harnessing the finest achievements of human efforts—the sheer, clean beauty of line of the fast jet plane, the great, sleek power of a great transoceanic plane, the great aspirations of harnessed atomic energy—to the purposes of mutual annihilation. Whatever philosophy, psychiatry, or religion may have had to offer mankind—the proof of their ineffectiveness is in

the records of the years. Each of those great efforts to help men has, whatever its inherent merits may have been, simply and conclusively failed.

Anyone who has tried to get a fear-stricken child to accept a pill that will cure its lethal illness knows one physical equivalent of the situation. The medicine has the power to cure the child; the child is wildly resisting the administration of the medicine. It makes no difference how good the medicine is—unless it can be accepted, it is useless.

The psychoanalyst who says "He came to me but I could not help him because he would not co-operate" is expressing the problem, too. The self-evident fact that you can drive a man to work with a whip, but you can not force him to think as you wish, is part of it. The analyst who says "he would not co-operate" must recognize that that is *not a failure of the patient*; it is a failure of psychoanalysis. The man came for help because he had mental problems; the first problem was the mental problem of gaining access to the core of the problem. If the doctor cannot induce the child to take the pill, that is not a failure of medicine, because medicine is the science of physical illness. But if the psychoanalyst cannot entice the patient to take the medicine—that is a failure of the technology, for that failure *is* a mental problem.

Psychoanalysis *will* help those who accept it. Philosophy, even more, can help those who accept and

truly understand. Religion has even greater power to help—for some. What is it, though, that keeps men from understanding and accepting? None of these helpful mental disciplines is applicable or useful until some resistance that seems to be built into Man is somehow overcome.

Generations of philosophers and mystico-ethical philosophers have repeatedly said, through thousands of years, that the distractions of the flesh and of earthy things prevents one from attaining to a higher understanding. That the individual must overcome his fleshly wants to achieve the perfect peace of greater understanding. That—it's been phrased in a thousand semimystical ways. The essence is that you have to ignore and reject the body in order to bring peace to the mind.

It hasn't worked for many people. A handful of men in each generation, but not much more.

Actually, what Hubbard has in dianetics is precisely the same basic recognition—with a complete reversal of the answer to the problem. Dianetics is simply a technique for facing and understanding the problems of the flesh, or in less quasi-mystical terms, the mechanical problems of the environment are impacted mechanically on our perceptive apparatus, the physical body, and until those problems are considered, evaluated and resolved, we cannot handle properly the problems of the mind itself.

Consider this: Suppose you are

trying to carry out some purely intellectual operation—writing an article, painting a picture, computing a complex problem. This is a purely mental function, with a minimum of physical problem. But you are working in a room where the temperature is 100°, there is gravel in your shoes, the humidity is ninety per cent, the seat of the chair is broken, and pinches you every time you move, and a squadron of mosquitoes is humming around the room.

There are, theoretically, two methods of handling this situation. Number One is the ancient philosophical method, the method of the mystics. You can be bigger than these petty physical annoyances, ignore them—rise above them—refuse to pay any attention to the distractions of the flesh, and go on to higher things. If you succeed in getting yourself into a semihypnotic trance, you may achieve that.

The second method is as follows: Get a new chair. Take off your shoes and dump out the gravel. Get a D.D.T. bomb and eliminate the mosquitoes. Get an air conditioner, or at least a fan. Go take a shower to remove accumulated sweat, put on fresh linen, and then buckle down and really tear that mental problem apart.

It seems clear that the second method is more apt to produce more results in less time for most human beings.

Hubbard's dianetics is simply the second answer to the problem of the "distractions of the flesh"—stop

kidding yourself that they aren't distractions, stop trying to ignore them, and find out what they really are. Then solve those.

After that, you can really tackle the main problem; the problem of the mind.

Hubbard did not have, in dianetics, the cure-all for mental problems, as he believed—but he did have the *essential missing key*. Dianetics is a technique by which the mechanical problems of the physical organism can be faced and resolved. After that, the mental problems are clarified, and can be handled rapidly and effectively. But no human being can handle the problems *without* facing and resolving the problems of his own physical past.

However, when the physical problems *have* been faced and resolved, then—the old philosophers were quite correct; mental peace through understanding undoubtedly can be achieved. But that is quite definitely beyond the scope of dianetics as originally presented. The immense importance of dianetics is that it gives us a technique whereby the physical problem *can* be tackled and resolved.

Psychology has long maintained that the human personality is made up of heredity and environmental factors. Accepting their statement as correct and complete for the moment—it is not complete; too many mystical philosophers have insisted that there is *something* beyond those two factors to permit a true sci-

entific analysis to ignore it completely—we can analyze the factors they do consider. Heredity is pretty clearly beyond therapeutic influence; if a man has a certain set of genetic characteristics, that's pretty thoroughly and definitely that. Then environment is all that's left to be worked with.

Actually, of course, "personality" is the resultant generated by the interaction of heredity and environment, and is absolutely distinct from either. Electrical charge is generated when a conductor is moved through a magnetic field; personality is generated when a certain structure—a human body determined by heredity—is moved temporarily through an environment field. But electric charge is *not* magnetism, and is *not* mechanical energy of translation—it's a separate thing-in-itself. Similarly, personality is *not* heredity, it is *not* environment, but a thing-in-itself generated by the interaction of a physical organism and its environment.

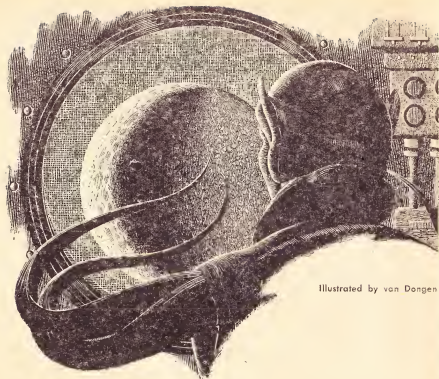
The confusion there is rather general and has led to some fancy misunderstandings. Hubbard developed his work pragmatically, and his theoretical material needed a great deal of re-evaluation and reformulation, the kind of work that required many new minds. Newton's famous Laws of Motion weren't theoretical material—they were merely codification of observational data, and generalizations drawn from those observations. Einstein's work, generations later, is beginning to give us a the-

ory of gravity and the laws of motion. But Newton's observational codifications have been vastly useful. Hubbard's observation-codification is equally basic and useful in the field of the mind—however far off his theories may or may not be.

And the most important consideration implicit in Hubbard's work is the recognition that *environment and the physical organism are both purely mechanical*. The *process* of thinking is purely mechanical—as evidenced by the fact that computer machines can duplicate most of the processes of thinking; only greater complexity is needed to get a fair approximation of the human thinking process.

Environment is purely mechanical; when someone speaks to you, no words reach your ears—only sound waves. Sound waves have no meaning, no intelligence, no emotional connotation *except as your mind implants them*. Consider the familiar wolf-whistle. That is simply and solely a series of musical notes, a sound-wave complex that a physicist could analyze, formulate, and re-synthesize. Such a whistle, reaching the ears of a Roman girl of Caesar's time, for instance, would have no emotional or intellectual evaluation whatsoever. It is, was, and always will be a series of sound waves, and nothing whatsoever beyond that.

Significance does *not* lie in the environment; it lies in the *integration of experience and thought-emotion*
(Continued on Page 160.)



Illustrated by van Dongen

ICEWORLD

BY HAL CLEMENT

First of three parts. The first novel in over half a year brings Hal Clement telling of an interstellar narcotics agent and a world of terrible, unapproachable cold—our earth!

Sallman Ken had never been really sure of the wisdom he had shown in acceding to Rade's request. He was no policeman and knew it. He had no particular liking for physical danger. He had always believed, of course, that he could stand his share of discomfort, but the view he was now getting through the *Karella's* port was making him doubt even that.

Rade had been fair enough, he had to admit. The narcotics chief had told him, apparently, everything he himself knew; enough so

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that Ken, had he used his imagination sufficiently, might even have foreseen something like *this*.

"There has never been much of it," Rade had said. "We don't even know what the peddlers call it—it's just a 'sniff' to them. It's been around for quite a few years now; we got interested when it first appeared, and then took most of our attention from it when it never seemed to amount to much."

"What's so dangerous about it then?" Ken had asked.

"Well, of course any habit-forming drug is dangerous—you could hardly be a teacher of science without knowing that. The special menace of this stuff seems to lie in the fact that it is a gas, and can therefore be administered easily without the victim's consent; and it seems to be so potent that a single dose will insure addiction. You can see what a public danger that could be."

Ken had seen, clearly.

"I should say so. I'm surprised we haven't all been overcome already. A generator in a building's ventilation system—on board a ship—anything like that could make hundreds of customers for whoever has the stuff to sell. Why hasn't it spread?"

Rade had smiled for the first time.

"There seems to be two reasons for that, also. There are production difficulties, if the very vague stories we hear have anything in them; and the stuff doesn't keep at normal temperature. It has to be held under extreme refrigeration; when exposed

to normal conditions it breaks down in a few seconds. I believe that the active principle is actually one of the breakdown products, but no one had obtained a sample to prove it."

"But where do I come in? If you don't have any of it I can't analyze it for you. I probably couldn't anyway—I'm a schoolteacher, not a professional chemist. What else can I do?"

"It's because you're a teacher—a sort of jack-of-all-trades in scientific matters, without being an expert at any of them—that we think you can help us. I mentioned that there seemed to be production troubles with the drug.

"Certainly the producers would like to increase volume. They would like, of course, to get a first-rate production engineer. You know as well as I that they could never do it; no such person could be involved secretly in such a matter. Every competent engineer is well employed since *velio* was discovered, and it would be too easy for us to trace one who was approached for such a purpose.

"You, however, are a comparatively inconspicuous person; you are on vacation, and will be for another year; no one will miss you—we expect these people to think. That's why we took such extreme precautions in arranging this interview."

"But you'll have to publicize me some way, or *they* would never know I existed, either," Ken pointed out.

"That can be done—in fact, has already started. I trust you'll for-

give us for that ; but the job is important. The whisper has already started in criminal circles that you are the manufacturer of the bomb that wrecked the Stornn plant. We can give you quite a reputation—"

"Which will prevent my ever getting an honest job again."

"Which will never be heard of by your present employers, or by any respectable person not associated with the police."

Ken was not yet sure why he had accepted. Maybe the occupation of policeman still carried a little subconscious glamour, though certainly it was now mostly laboratory work. This looked like an exception—or did it? He had, as Rade expected, been hired by an extremely short-spoken, individual, who claimed to represent a trading concern. The understanding had been that his knowledge was to be placed at the disposal of his employers. Perhaps they would simply stick him in a lab with the outline of a production problem, and tell him to solve it. In that case, he would be out of a job very quickly, and if he were lucky might be able to offer his apologies to Rade.

For he certainly had learned nothing so far. Even the narcotics man had admitted that his people knew no one at all certainly connected with the ring, and it was very possible that he might be hired by comparatively respectable people—compared, of course, to drug runners. For all Ken could tell at the

moment, that might have happened. He had been shepherded aboard the *Karella* at the North Island spaceport, and for twenty-two days had seen nothing at all.

He knew, of course, that the drug came from off the planet. Rade had become sufficiently specific to admit that the original rush had been checked by examining incoming refrigeration apparatus. He did not know, however, that it came from outside the Sarrian planetary system. Twenty-two days was a long journey—if it had been made in a straight line.

Certainly the world that hung now beyond the port did not look as though it could produce anything. Only a thin crescent of it was visible, for it lay nearly between the ship and a remarkably feeble sun. The dark remainder of the sphere blotted out the Milky Way in a fashion that showed the planet to be airless. It was mountainous, inhospitable, and cold. Ken knew that last fact because of the appearance of the sun. It was dim enough to view directly without protection to the eyes ; to Ken's color sense, reddish in shade and shrunken in aspect. No world this far from such a star could be anything but cold.

Of course, Rade's drug needed low temperature—well, if it were made here, Ken was going to resign, regardless. Merely looking at the planet made him shiver.

He wished someone would tell him what was going on. There was a speaker over the door of his room,

but so far the only times it had been used was to tell him that there was food outside his room and the door was unlocked for the moment.

For he had not been allowed to leave his room. That suggested illegal proceedings of some sort; unfortunately it did not limit them to the sort he was seeking. With the trading regulations what they were, a mercantile explorer who found an inhabited system more often than not kept the find strictly for his own exploitation. The precaution of concealing its whereabouts from a new employee was natural.

At a venture, he spoke aloud. After all, the fact that they were hanging so long beside this world must mean something.

"Is this where I'm expected to work? You'll pardon my saying that it looks extremely unpleasant." A little to his surprise there was an answer, in a voice different from the one that had announced his meals.

"I agree. I have never landed there myself, but it certainly looks bad. As far as we know at present, your job will not require you to visit that world."

"Just what is my job? Or don't you want to tell me yet?"

"There is no harm in telling you more, anyway, since we have arrived at the proper planetary system."

Ken cast an uneasy eye at the feeble sun as he heard these words, but continued to listen without comment.

"You will find the door unlocked.

Turn to your right in the corridor outside, and proceed for about forty yards—as far as you can. That will take you to the control room, where I am. It will be more comfortable to talk face to face." The speaker's rumble ceased, and Ken did as he was told.

The *Karella* seemed to be a fairly common type of interstellar flier, somewhere between one hundred fifty and two hundred feet in length, and about one third that diameter. It would be shaped like a cylinder with slightly rounded ends. Plenty of bulk—usable for passengers, cargo, or anything else her owner cared.

The control room contained nothing worthy of comment, except its occupants. One of these was obviously the pilot; he was strapped to his rack in front of the main control panel. The other was floating free in the middle of the room, obviously awaiting Ken's arrival since he had both eyes on the door. He spoke at once, in a voice recognizable as the one which had invited the scientist forward.

"I was a little hesitant about letting you see any of us personally before having your final acceptance of our offer; but I don't see that it can do much harm, after all. I scarcely ever visit Sarr nowadays, and the chance of your encountering me if we fail to reach a final agreement is small."

"Then you are engaged in something illegal?" Ken felt that there

could be little harm in mentioning a fact the other's speech had made so obvious. After all, they would not expect him to be stupid.

"Illegal, yes, if the law be interpreted—strictly. I feel, however, and many agree with me, that if someone finds an inhabited planet, investigates it at his own expense, and opens relations with the inhabitants, that he has a moral right to profit from the fact. That, bluntly, is our situation."

Ken's heart sank. It began to look as though he had stumbled on the very sort of petty violation he had feared, and was not going to be very useful to Rade.

"There is certainly some justice in that viewpoint," he said cautiously. "If that is the case, what can I do for you? I'm certainly no linguist, and know next to nothing of economic theory, if you're hitting trading difficulties."

"We are having difficulties, but not in that way. They stem from the fact that the planet in question is so different from Sarr that personal visits are impossible. We have had the greatest difficulty in establishing contact of a sort with even one group of natives—or perhaps a single individual; we can't tell."

"Can't tell? Can't you send a torpedo down with television apparatus, at least?"

"You'll see." The still nameless individual gave a rather unpleasant smile. "At any rate, we have managed to do a little trading with this native or natives, and found that

they have something we can use. We get it, as you can well imagine, in trickles and dribbles. Basically, your problem is—how do we get more of it? You can try to figure out some way of landing in person if you like, but I know you're not an engineer. What I thought you could do was get a good enough analysis of the planet's conditions—atmosphere, temperature, light, and so on—so that we could reproduce them in a more convenient location and grow our own product. That way, we wouldn't be forced to pay the price the native asks, too."

"That sounds simple enough. I notice you don't seem to want me to know what the product is—except that it seems to be of vegetable nature—but that doesn't bother me. I had a friend in the perfume business once, and the way he tried to keep secrets in elementary chemistry was a scandal. I'm certainly willing to try—but I warn you I'm not the best chemist by a long shot, and I've brought no apparatus with me, since I didn't know what you wanted me to do. Have you anything here in the ship?"

"Not in the ship. We discovered this place around twenty years ago, and have built a fairly comfortable base on the innermost planet of this system. It keeps the same hemisphere facing the sun all the time, and we've been able to concentrate enough sunlight in a small valley to make the temperature quite bearable. There's a fairly respectable laboratory and shop there, with a

very good mechanic named Feth Allmer; and if you find yourself in need of something we don't have, we can probably afford to get it for you. How does that sound?"

"Very good indeed. I'll take your job, and do what I can."

Ken was a little happier at this point, partly because the job seemed interesting in itself and partly because of some of the other's statements. If this product were a plant, as seemed to be the case, there was at least a slight possibility that he was not on a blind run after all. The matter of the need for refrigeration, of course, had not come up specifically—for all that had been said so far, the planet was as likely to be too hot as too cold for comfort; but what he had seen of this system's sun made that seem doubtful. Then there was the reference to warming the *innermost* planet—no, the place was cold. Definitely. Chances improved again. He switched his attention from these thoughts, as he realized that his employer—if this was really the head of the concern—was speaking again.

"I was sure you would. You can give orders for anything you need, starting now. You may use this ship as you please, subject only to Ordon Lee's veto if he considers the vessel in danger." The pilot was indicated by the wave of a supple tentacle as the name was pronounced. "Incidentally, I am Laj Drai. You are working for me, and I am sure we will both be more comfortable if that

fact is borne in mind. What do you think should be done first?"

Ken decided to ignore Drai's subtle implication of superiority, and answered the question with another.

"Do you have any samples of the atmosphere or soil of this planet?"

"Of the first, no. We have never been able to keep a sample; probably we did not collect it properly. One cylinder that was collected leaked and burned in our air, for what that may be worth. We do have bits of soil, but they were all exposed to our own air at one time or another, and may have been changed by that. You will have to decide that for yourself. All that I really know is that their atmosphere has a pressure around two thirds of Sarr-normal, and at its base the temperature is low enough to freeze most of the regular gases out of our own air—I believe it would even freeze potassium. Our mechanic claimed that was what happened to one device that failed to work."

"How about size?"

"Bigger than Saar—the figures are all at the base on Planet One; it would be easier to look them over there. I don't pretend to remember any of them at all precisely—as a matter of fact, we don't *have* any of them too precisely. You're the scientist, as far as we are concerned; my people are just eyes and tentacles for you.

"We do have remote-controlled torpedoes, as you suggested. It might be well to tell me before you

use them; we lost nineteen of the first twenty to reach the planet's surface. We planted a permanent transmitter at the point where the twentieth landed, and we always home down on it now. Just what happened to the others we don't exactly know, though we have a pretty good guess. I'll tell you the whole story at the same time that you look over the other material. Is there anything you'd care to do before we leave the vicinity of the planet and go over to One?"

"Leave the vicinity? I thought you said that world was not the one in question." Ken waved a tentacle at the cratered crescent.

"That one isn't—that's a satellite of Three, the one we're interested in."

A chill came back to Ken's skin. The satellite had been frightening; the planet itself could be little if any warmer since it must be about the same distance from the sun. An atmosphere would help a little, of course; but still—cold enough to freeze potassium, and lead, and tin! He had not given real thought to that. His imagination was good—perhaps a little too good; and it began conjuring up out of nothing in particular an image of a world chilled to the core. It was rough, and an icy blizzard played over it, and nothing moved in the dim reddish light—a planet of death.

But that couldn't be right; there were natives. Ken tried to imagine the sort of life that could exist under

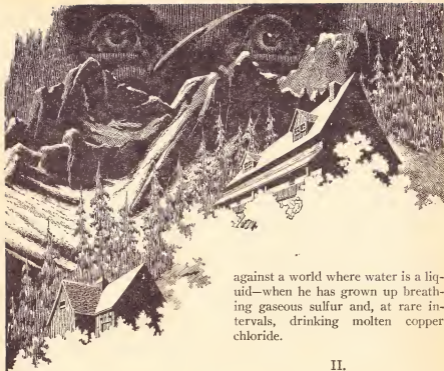
such hideous conditions, and failed completely. Maybe Laj Draï was wrong about the temperature; after all, he hadn't been *sure*. It was just a mechanic's opinion.

"Let's see this place, since we're so close to it. I might as well learn the worst," he said at this point in his imagining.

Laj Draï gestured to the pilot, and the hull of the *Karella* rotated slowly. The airless satellite slid out of sight, and stars followed it across the field of view. The ship must have spun a full hundred and eighty degrees before Planet Three itself hung in the apparent center of the port. They must be floating directly between planet and satellite, Ken thought. Not wise if the inhabitants had telescopes.

Since the sun was now behind them, the disk of the great world was fully illuminated. Unlike the bare moon, a fuzziness of outline showed that it possessed an extensive atmosphere, though Ken could not imagine what gases might be present. In spite of the definitely reddish sunlight, most of the surface had a decided blue tint. Details were impossible to make out; the atmosphere was extremely hazy. There were definite patches of white, and green, and brown, but there was no way of telling what any of them represented.

And yet, foggy as it was, there was something about the sight of the world which caused the shiver to caress the scientist's skin once more. Perhaps it was the things he had



against a world where water is a liquid—when he has grown up breathing gaseous sulfur and, at rare intervals, drinking molten copper chloride.

II.

been told, and the things he had deduced from the appearance of the sun; perhaps it was nothing objective at all. Whatever it was, the very sight of the world made him shudder, and he turned away abruptly.

"Let's go to One, and look over that data," he said, striving to control his voice diaphragm.

The pilot obeyed without comment.

Earth, really, is not as bad as all that. Some people are even quite fond of it. Ken, of course, was prejudiced, as anyone is likely to be

Roger Wing, for example, would probably have been slightly shocked at Ken's attitude. He was strongly in favor of Earth, at least the rather small portion which he knew. He had some justification, for the country around Lake Pend' Oreille is very much worth knowing, particularly in spring and summer. The first glimpse of the lake each June was something to look forward to; all the way up the highway from Hayden Lake the children maintained shrill rivalry over who would be the first to sight the Ear Drop. Even with only four of them this

year, the noise was nearly as great as usual; for the absent Donald had never contributed too much to the racket. Roger, left the senior member by his older brother's absence, was determined to make the most of the opportunity; the more so since it was to last only another forty miles or so. Don was expected to fly to Sandpoint with a friend and meet the family there.

It was, all in all, a hilarious group; and the parents in the front seat had only moderate success in maintaining order. However, the north-bound highway from Coeur d'Alene is a good one, and the disturbance in the rear was never really dangerous. The principal interruption occurred when the right rear tire of the station wagon went flat near Cocolalla. John Wing was a little slow in stopping the heavily loaded vehicle, and Roger got the first whiff of the sulfurous odor of burning rubber. He was to become much more familiar with sulfur during the course of the summer.

The children were a little quieter after that—the expression on their father's face suggested that his patience might not have much farther to go; but the journey was never really silent. The causeway across the tip of Pend' Oreille was greeted with ringing cheers, which ceased only momentarily while Mr. Wing purchased a new tire in Sandpoint. Then they proceeded to the small airport at the edge of the town, and the noise increased again as the youngsters caught sight of their old-

est brother standing beside a Cub on the grass parking area.

He was tall, and rather slim, with dark hair and eyes and a narrow face like his father's. Roger, who had grown considerably since the last September, discovered to his chagrin that Donald still overtopped him by half a head; but he did not let the annoyance lessen the exuberance of his greeting. Don shook hands with his father and Roger, kissed his mother and sisters, and swung six-year-old Billy to his shoulder. No, the flight from Missoula had not been eventful. Yes, his final grades had been good, if not outstanding. No, he had no luggage except the little handbag beside him—a Cub has sharp load limitations. They might as well continue their journey, and he could answer questions on the way. He tossed the bag at Roger and moved toward the station wagon, Billy still on his shoulder; and with the crowd settled more or less comfortably, they rolled on.

North from Sandpoint; east fork to Kootenai; around the north end of the question-mark-shaped lake to Hope, and on to Clark Fork. There the car was left, in a building that partook of the characteristics of storehouse and garage.

Don and Roger disappeared, and returned with an imposing array of pack and saddle horses. These were accoutered with a speed which suggested the maneuver was not a new one to the family; and the Wings, waving farewell to their acquaint-

ances who had gathered to see them off, headed northward into the woods.

Donald grinned at his father as the town vanished behind them.

"How many campers do you suppose we'll have this year?"

"It's hard to say. Most of the folks who know us have come to mind their own business pretty well, and I didn't notice any strangers in the town; but prospectors seem to turn up when least expected. I don't mind honest prospecting—it lends protective coloration. It's the ones who expect to benefit from our 'strike' that bother me. You boys will have to scout as usual—though I may want Don with me this time. If you've really got something out of freshman chemistry, Son, you may be able to help solve a problem or two. If he does go with me, Roger, you'll have a bigger responsibility than usual." The boy nodded, eyes shining.

He had only gradually come to realize the tremendous difference between the way his family and those of his schoolmates spent their summers. At first, the tales of trips to ranches, seashores, and mountains had aroused his envy; then he had begun to boast of his own mountain trips. When he finally realized the atmosphere of secrecy that surrounded certain aspects of those trips, his pride had exceeded his powers of restraint—until he had realized that his schoolmates simply didn't believe that his father had a "secret

mine in the mountains." Pique had silenced his boasts for a while and by the time he had developed a convincing argument he had realized that silence might be better for all concerned.

That had been the spring when he was ten years old. His father had somehow heard about the whole story, and seemed pleased for some reason; that summer he had extended to Roger the responsibility which Don had been carrying alone, of scouting the territory around their summer home before and during Mr. Wing's trips into the mountains. The find, their father had told him, was his own secret; and for reasons he would explain later it must be kept that way.

That summer and the two following he had continued to make his trips alone; now it looked as though there might be a change. Don, Roger knew, had been told a little just before leaving for college the preceding fall; his courses had been partly selected on the basis of that information—chemistry, astronomy and mathematics. The first seemed logical, but Roger failed to see the point of the others. Certainly astronomy seemed of doubtful value in anything connected with mining.

Still, he would find that out in due course; perhaps sooner than Don had, since their father seemed to be letting down the bars. His problem for the moment was to figure out a way by which one boy could keep himself informed about every person who came within a mile of the

summer house in any direction—and farther than that in some directions. Roger, of course, knew the topography of the neighborhood quite well; but he began right then planning a series of exploration jaunts to make more certain of some points. He was a young man who took things seriously, if they were presented to him in that light.

Like anyone else of his own age, however, he tended even more strongly to fly off on the interests of the moment; and he was easily aroused from his reverie when Edie caught him in the face with a fir cone slyly tossed over her shoulder. She burst into laughter as he looked around fruitlessly for a means of retaliation—there seemed to be no more cones within reach, and the trail at this point was too narrow for the horses to travel side by side. The pack horse the girl was leading formed, for the time being, an impassable barrier.

"Why don't you wake up and join the party?" Edith finally gurgled out between spasms of laughter. "You looked as though you'd just remembered leaving your favorite fishpole in Spokane!" Roger assumed a mantle of superiority.

"Of course, you girls have nothing to do between now and September," he said. "There's a certain amount of men's work to be done, though, and I was deciding how to go about it."

"Men's work?" The girl raised her eyebrows in mock surprise. "I

know Dad will be busy, but what's that to you?" She knew perfectly well what Roger's summer duties were, but had reasons of her own for speaking as she did. "Does it take a man to stroll around the house on sentry-go a couple of times a day?" Roger stiffened.

"It takes more than a girl to do a good job of it," he retorted. The words were hardly out when he regretted them; but he had no time to think of a way out of the corner into which he had talked himself.

"Evidence!" Edith responded quietly, and Roger mentally kicked himself. She had been playing for just that. Family rules required that any statement made by a member of the family be backed up with evidence if another member required it—a rule the elder Wing had instituted, with considerable foresight. He was seldom caught by it himself, being a thoughtful man by nature.

"You'll have to let me try, now," Edith remarked, "and you'll have to give me a fair amount of teaching. To be really fair, you'll have to let Margie try, too—" The last was an afterthought, uttered principally for its explosive effect.

Roger almost left his saddle, but before he succeeded in expressing himself a thought struck him. After all, why couldn't the girls help? He could show them what he and Don had done in the past, and they might very well have ideas of their own. Roger's masculine pride did not blind him to the fact that girls in general, and his sisters in particu-

lar, did have brains. Edie and Marge could both ride, neither was afraid of the woods, and all things considered would probably make extremely useful assistants. Edith was so near to his own age that he could not dismiss her as too young for the work, and even the eight-year-old had at least sense enough to keep quiet when silence was needed and obey orders when argument would be injudicious.

"All right. You can both try it." Roger brought his cogitation to an end. "Dad won't mind, I guess, and Mother won't care if the work gets done. We'll have a conference tonight."

The conversation shifted to other matters, and the caravan wound on up the river. Two or three hours out of Clark Fork they crossed the stream and headed eastward toward the Montana border; and there were still several hours of daylight remaining when they reached the "summer cottage."

It was hardly a cottage. Built up on a steep hillside, though still below the timber line, it boasted enough rooms to house the Wing family without any fear whatever of crowding. It possessed a gasoline-powered electric plant, a more or less limited supply of running water piped from a spring farther up the hill, and in general bore witness to Mr. Wing's luck or skill in the prospecting which was supposed to be the source of his income.

A short distance downhill from

the dwelling was another building which combined the functions of storehouse and stable. Both structures were solidly built, and had never suffered serious damage from the northwest winters. The foundation of the house was part of the bedrock core of the mountain, and its walls were well insulated. The family could easily have lived there the year round, and the parents had vague plans of doing so once the children had all finished school.

The first floor consisted of a big room which did duty as dining room and parlor, with a kitchen at one end and bedroom at the other. An open stair well by the kitchen door went down to a basement, containing workbenches cluttered with woodworking and radio paraphernalia as well as the wherewithal for various games. The stair to the second floor was at the other end; this was divided into six much smaller rooms, one serving as bedroom for each of the children and the remaining one filled with the various odd articles of furniture and bric-a-brac which are apt to find their way into a spare room over a period of years.

The Wings dismounted by the porch which ran along the front of the dwelling, and promptly dispersed to their various duties. Mrs. Wing and the girls unlocked the front door and disappeared inside. Billy began unscrewing and removing the shutters on the more accessible windows—those along the

porch, and the first-floor ones on the uphill side of the dwelling. Mr. Wing and Donald began unloading the pack animals, while Roger took the other horses down to the stable, unsaddled, and fed them.

By sunset, the house had assumed an inhabited air. Everyone had eaten, dishes had been washed, Billy and Marjorie were in bed, and the remaining members of the family had settled down for a few minutes of relaxation in the main room. There had been some debate as to whether the fireplace should be used, which had been won by the affirmatives—not so much because of the temperature, though even a June night can be chilly in the Cabinets, but simply because they liked to sit around a fire.

The parents were ensconced in their respective seats on each side of the stone fireplace. Donald, Roger and Edith sprawled on rugs between; Roger had just put forth the suggestion that the girls help in the scouting job. His father thought for a minute or two.

"Do you know your way around well enough, in directions other than toward town?" he finally asked Edith.

"Not as well as the boys, I suppose, but they had to learn sometime or other," she countered.

"True enough. I wouldn't want you to turn up missing, and your mother can't be expected to do all the housework herself. Well, Roger seems to have let himself in for proving a point, so let's put it this way.

It will be a week or ten days before I go out for the first time. In that time the two of you, working together, will turn in a satisfactory map of the territory within three miles of this house, and a patrol schedule that will permit Edie's housework to be done at times satisfactory to your mother. Margie may go with you, but is not to go beyond the half-mile marks alone—the old rules hold for the younger people, still. That is subject to any additions or alterations your mother may see fit to make." He looked across at his wife, with a half smile on his face. She returned the smile, and nodded.

"That seems all right. Roger has a few duties of his own, I believe; hadn't they better be included in the last item?"

"Fair enough. Does that suit you, Rog? Edie? All right," as the two nodded, "time for bed. You seem to have the time for the next few days pretty well filled."

The two youngsters grimaced but obeyed; Don and his parents remained. They talked seriously in low tones far into the night. The four youngest children had been asleep for several hours when Donald finally climbed the stairs to his room, but the fact did not lessen his caution. He had no desire to spend the rest of the night ducking Roger's questions about what had gone on downstairs.

In spite of the rather strenuous day just finished, the entire family was up early the next morning. As

a "special favor" to his younger brother, Donald volunteered to take the surplus horses back to town—they kept only a few at the summer house, as fodder was a little difficult to obtain. That left the younger boy free, once the shutters were removed from the upstairs windows, to get out on the mapping job, as far as his own work was concerned. Edith was delayed for a while dusting off china and washing cooking utensils—they had cleaned only enough for a sketchy meal the night before—but Roger conquered any slight distaste he may have had for women's work and helped out. The sun was not yet very high when they emerged onto the porch, consulted briefly, and started uphill around the house.

The boy carried a small Scout compass and a steel tape which had turned up in the basement workshop; his sister had a paper-covered notebook, a school relic still possessed of a few blank pages. Between his father's teaching and a year in a Scout troop, Roger was sure he could produce a readable map of the stipulated area with no further equipment. He had not considered at all carefully the problem of contours.

High as the Wing house was located, there was still a long climb above it; and both youngsters were quite willing to rest by the time they reached the top. They were willing, too, to sit and look at the view around them, though neither was a stranger to it.

The peaks of the Cabinets extended in all directions except the west. The elevation on which they were located was not high enough to permit them to see very far; but bits of Pend' Oreille were visible to the southwest and the easily recognized tip of Snowshoe Peak rose between east and south. Strictly speaking, there was no definite timber line; but most of the peaks managed to thrust bare rock through the soil for at least a few hundred feet. The lower slopes were covered with forest, principally the Douglas fir which is so prevalent in the Pacific Northwest. One or two relatively clear areas, relics of forest fires of the last few years, were visible from the children's point of vantage.

There were a number of points visible within the distance specified by Mr. Wing which looked as though they might serve as reference stations, and presently Roger took out the compass and began taking bearings on as many of these as he could. Edith was already making a free-hand sketch map of their surroundings, and the bearings were entered on this. Distances would come later; Roger knew neither his own altitude nor those of the points he was measuring, and could not have used the information had he possessed it. He knew no trigonometry and had no means of measuring angles of depression.

Details began to crowd the rough chart even before they left the hill-top; and presently the two were completely absorbed in their task.

Mrs. Wing was not particularly surprised when they came in late for dinner.

III.

The station on Planet One was a decidedly primitive installation, though a good deal of engineering had obviously been needed to make it habitable at all. It was located in the bottom of a deep valley near the center of the planet's sunward hemisphere, where the temperature was normally around four hundred degrees Centigrade. This would still have been cold enough to liquefy the sulfur which formed the principal constituent of the atmosphere Ken's people needed; but the additional hundred degrees had been obtained by terracing the valley walls, cutting the faces of the terraces to the appropriate slope, and plating them with iron. The dark-colored metal dome of the station was, in effect, at the focus of a gigantic concave mirror; and between the angular size of the sun and the actual size of the dome, solar libration never moved the focus to a serious extent.

The interstellar flier settled onto a smooth sheet of bare rock beside the dome. There were no cradling facilities, and Ken had to don vacuum armor to leave the vessel. Several other spacesuited figures gathered in the air lock with him, and he suspected that most, if not all, of the ship's crew were "going ashore" at the same time though, of

course, they might not be crew; one operator could handle a vessel of the *Karella's* class. He wondered whether or not this was considered safe practice on a foreign planet; but a careful look around as he walked the short distance from ship to dome revealed no defensive armament, and suggested that those manning the station had no anxiety about attack. If, as had been suggested, the post had been here for twenty years, they probably should know.

The interior of the dome was comfortable enough, though Ken's conductor made constant apology for the lack of facilities. They had a meal for which no apology was required, and Ken was shown private quarters at least as good as were provided by the average Sarrian hotel. Laj Draï took him on a brief tour of the station, and made clear the facilities which the scientist could use in his assigned job.

With his "real" job usually in mind, Ken kept constant watch for any scrap of evidence that might suggest the presence of the narcotic he sought. He was reasonably certain, after the tour, that there was no complex chemical processing plant anywhere around; but if the drug were a natural product, there might not have to be. He could name more than one such substance that was horribly effective in the form in which it was found in nature—a vegetable product some primitive tribes on his own world still used to poison their arrows, for example.

The "trading" equipment, how-

ever, proved more promising, as might have been foreseen by anyone who had considered the planet with which the trading was done. There were many remote-control torpedoes, each divided into two main sections. One of these contained the driving and control machinery and was equipped with temperature control apparatus designed to keep it near normal; the other was mostly storage space and refrigeration machinery. Neither section was particularly well insulated, either from each other or the surrounding medium.

Ken examined one of the machines minutely for some time, and then began asking questions.

"I don't see any vision transmitter; how do you see to control the thing on the planet's surface?"

"There is none," a technician who had been assisting Lajrai in the exposition replied. "They all originally had them, of course, but none has survived the trip to Three yet. We took them out, finally—it was too expensive. The optical apparatus has to be exposed to the planet's conditions at least partly, which means we must either run the whole machine at that temperature or have a terrific temperature difference between the optical and electrical elements. We have not been able to devise a system that would stand either situation—something goes completely haywire in the electrical part under those freezing conditions, or else the optical section

shatters between the hot and cold sections."

"But how do you see to control?"

"We don't. There is a reflection altimeter installed, and a homing transmitter that was set up long ago on the planet. We simply send the torpedo down, land it, and let the natives come to it."

"And you have never brought any physical samples from the surface of the planet?"

"We can't see to pick up anything. The torpedo doesn't stay air-tight at that temperature, so we never get a significant amount of the atmosphere back; and nothing seems to stick to the outer hull. Maybe it lands on a solid metal or rock surface—we wouldn't know."

"Surely you *could* make the thing hold air, even below the freezing point of sulfur?"

"Yes, I guess so. It's never seemed to be worth the trouble. If you want a sample, it would be easier to send a smaller container down, anyway—you can work with it better afterwards."

A thought suddenly struck Ken.

"How about the stuff you get from the natives? Doesn't that give any clue? Could I work with some of it?"

Lajrai cut in at this point.

"You said you were not a specialist. We have tried to get the stuff analyzed by people who were, without success. After all, if it were possible to synthesize the material, do you think we'd be going to all this trouble to trade for it? That's why

we want you to get the planetary conditions for us—when you've done that, we'll figure out a means of getting seeds from the natives and growing our own."

"I see," Ken replied. The statement was certainly reasonable enough, and did not necessarily imply anything about the nature of the material they were discussing.

It did not refute anything, either.

Ken thought that one over for a time, letting his eyes wander over the exposed machinery as he did so. He had a few more questions in mind, but he wanted to dodge anything that might be interpreted as unhealthy curiosity, if these people actually were drug runners.

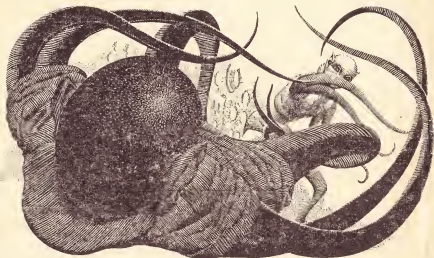
"What do these natives get from you for this product?" he asked finally. "Is it a manufactured article they

can't make, or a substance they don't have? In the latter case, I might be able to draw some conclusions about the planet."

Drai sent a ripple down his tentacles, in a gesture equivalent to a human shrug.

"It's material—heavy metals that don't sulfide easily. We've been giving them platinum-group nuggets most of the time—they're easiest to come by; there's an outcropping of the stuff only a short distance from this station, and it's easy to send a man out to blast off a few pieces. I don't know what they use them for—for all I know they may worship the torpedo, and use the nuggets as priests' insignia. I can't say that I care, as long as they keep filling their end of the bargain."

Ken made the gesture of agreement, and spoke of something



which had caught his attention during the last speech.

"What is a loud-speaker and microphone doing in that thing? Surely they don't work at the temperatures you mentioned—and you can't be speaking to these natives!"

The technician answered the first question.

"It works, all right. It's a crystal outfit without vacuum tubes, and should work in liquid hydrogen."

Drai supplemented the other answer. "We don't exactly talk to them, but they can apparently hear and produce sounds more or less similar to those of our speech."

"But how could you ever have worked out a common language, or even a code, without visual contact? Maybe, unless you think it's none of my business and will not be any help in what is, you'd better give me the whole story from the beginning."

"Maybe I had," Laj Drai said slowly, draping his pliant form over a convenient rack. "I have already mentioned that contact was made some twenty years ago—our years, that is; it would be nearer thirty for the natives of Planet Three.

"The *Karella* was simply cruising, without any particular object in view, when her previous owner happened to notice the rather peculiar color of Planet Three. You must have remarked that bluish tint yourself. He put the ship into an orbit at a safe distance beyond the atmosphere, and began sending down torpedoes. He knew better than to go down himself—there was never any

doubt about the ghastly temperature conditions of the place.

"Well, he lost five projectiles in a row. Every one lost its vision connection in the upper atmosphere, since no one had bothered to think of the effect of the temperature on hot glass. Being a stubborn character, he sent them on down on long-wave instruments, and every one went out sooner or later; he was never sure even whether they had reached the surface. He had some fair engineers and plenty of torpedoes, though, and kept making changes and sending the results down. It finally became evident that most of them were reaching the surface—and going out of action the instant they did so. Something was either smashing them mechanically or playing the deuce with their electrical components.

"Up to then, the attempts had all been to make the landings on one of the relatively smooth, bluish areas; they seemed the least complicated. However, someone got the idea that this steady loss of machines could not be due to chance; somewhere there was intelligent intervention. To test the idea, a torpedo was sent down with every sort of detecting and protecting device that could be stuffed aboard—including a silver mesh over the entire surface, connected to the generators and capable of blocking any outside frequency which might be employed to interfere with control. A constantly changing control frequency was

used from our end. It had automatic heat control—I tell you, it had *everything*. Nothing natural and darned little that was artificial should have been able to interfere with that machine; but it went out like the others, just as the reflection altimeter reported it as almost touching the surface.

“That was enough for the boss. He accepted as a working theory the idea that a race lived on the flatter parts of the planet; a race that did not want visitors. The next torpedo was sent to one of the darker, rougher areas that could be seen from space, the idea being that these beings might avoid such areas. He seems to have been right, for this time the landing was successful. At any rate, the instruments said the machine was down, it proved impossible to drive it lower, and it stayed put with power off.

“That was encouraging, but then no one could think of what to do. We still couldn’t see, and were not certain for some time whether or not the microphone was working. It was decided not to use the loud-speaker for a while. There was a faint humming sound being picked up whose intensity varied without apparent system, which we finally decided might be wind rather than electrical trouble, and once or twice some brief, harsh, quite indescribable noises which have not yet been identified; the best guess is that they may have been the voices of living creatures.

“We kept listening for a full rota-

tion of the planet—nearly two of our days—and heard nothing else except a very faint buzzing, equally faint scratching sounds, and an irregular tapping that might or might not have been the footsteps of a hoofed creature on a hard surface. You may listen to the records we made, if you like, but you’d better have company around when you do. There’s something weird and unnerving about those noises out of nothing.

“I forgot to mention that the cargo port of the torpedo had been opened on landing; and microphones and weight detectors set to tell us if anything went in. Nothing did, however—a little surprising if there were small forms of wild life; the opening would have made a natural-looking shelter for them.

“Nothing even remotely suggestive of intelligence was heard during that rotation; and it was finally decided to use the loud-speaker. Someone worked out a schedule—starting at minimum power, repeating a tape for one rotation of the planet, then repeating with doubled output and so on until we reached the maximum which could be attained with that equipment. The program was followed, except that the boss was getting impatient and arranged to make the step-up each quarter rotation instead of the suggested time. Some humorist recorded a poem on the tape, and we started broadcasting.

“The first result was a complete cessation of the sounds we had tenta-

tively associated with life forms. Presumably they *were* small animals, and were scared away by the noise. The wind, if that's what it was, continued as expected. The first time we increased the noise, after a quarter rotation of the planet, we began to get a faint echo. That suggested that the sound was at least not being muffled very close to the speaker, and if any intelligent beings came within a considerable radius they would hear it.

"To make a long story short, we got a response after the fourth increase of power. We thought it was a distorted echo at first, but it got louder while our power remained constant, and finally we could tell that the sounds were different. They formed a tremendously complex noise pattern, and every one of us who heard them was sure from the beginning that they represented intelligent speech.

"Eventually we began to hear more footstep-sounds between the bursts of alien language, and we cut off our own broadcast. It became evident that the creature was close enough to detect the torpedo by other means than hearing, for the footsteps continued to approach. At first they were interrupted every few seconds by a loud call; but presently the thing must have actually reached the machine, for the sounds suggested that it was walking around at a nearly constant distance, and the calls were replaced by much less powerful but longer and more com-

plex speech-noises. Probably the creatures can see much as we do, though the light is so much weaker on that planet.

"Presently the photocell inside the cargo department indicated that something had cut off much of the light. One of the operators moved to close the door, and the boss knocked him clean out of the control room. He took the torpedo controls himself, and began attempting to imitate the voice sounds of the creature we couldn't see. That produced results, all right! If noise means anything, the native got wildly excited for a minute or two; then he buckled down to producing apparently as wide a variety of sounds as his vocal apparatus would permit. Certainly we couldn't imitate them all.

"That lasted for some time, with nobody making any real progress. Nobody had any way of telling what any of the other fellow's noises meant, of course. It began to look as though we'd gone as far as we could, in learning about the planet, and that the knowledge was not going to do anyone any good.

"Then someone remembered the old swap-boxes. I don't know whether you've heard of them; they were used, I guess, before our race ever left the home planet, when people who didn't speak each other's language wanted to trade. They are simply two trays, hinged together, each divided into a number of small compartments. One side is empty, while the compartments of the

Other are filled with the various articles that are for sale. A glass lid covers each of the full compartments, and cannot be removed until something has been placed in the corresponding compartment of the other tray. It takes a pretty stupid savage not to get the idea in fairly short order.

"We didn't have any such gadget, of course, but it was not difficult to rig one up. The trouble was that we could not tell what had been put in the empty tray until the box came back to us. Since we were more interested in talking than trading, that didn't matter too much at the time. We sent the box down in another torpedo, homing it on the location signal of the first and hoping the flatland people wouldn't detect it, opened the thing up, and waited.

"The native promptly investigated; he was apparently intelligent enough to put curiosity ahead of fear, even though he must have seen the second torpedo in flight. He behaved exactly as expected with the box, though of course we couldn't watch him—he put something in every compartment of the empty section, and presumably cleaned out the other; but he put most of the stuff back. One of the things he gave us proved useful—the stuff we still trade for—so we sent the box back with only the compartment corresponding to the one he had put that stuff in full. He got the idea, and we've been on fine terms ever since."

"But about the language?"

"Well, we know his words for 'yes' and 'no,' his names for a few metals and his name for the stuff he sells us. I can give you either a tape of his pronunciation or a written record, if you want to talk to him."

"Thanks a lot. That makes the whole situation a good deal clearer. I take it you have had no more trouble from these flatlanders?"

"None. We have carefully avoided contacting any other part of the planet. As I said, our interests are now commercial rather than scientific. Still, if you want to send down machines on your own, I suppose we shouldn't interfere with you. Please be careful, though; we'd hate to have contact cut off before we were in a position to do our own producing."

Ken gave the equivalent of a grin. "I notice you are still carefully refraining from telling me what the stuff is. Well, I won't butt in. That's none of my business, and I don't see how knowing it could help me out. Right now, I guess, it would be best for you to give me all the physical data you have on the planet. Then I can make a guess at its atmosphere, and send a torpedo down with equipment to confirm or deny the guess. That will be easier than trying to bring back samples for analysis, I imagine."

Drai pulled himself together from the rack on which he was sprawled, and gave the equivalent of an affirmative nod. "I'm not saying you shouldn't know what we get from the planet," he said. "But I shall

most certainly make a hammock from the skin of the first member of this organization who lets you find out!"

The technician, who had been listening in the background, turned back to the mechanism of another torpedo, and spoke for the first time without looking up.

"That won't be difficult; there's little to tell. The planet is about three-tenths larger than ours in diameter, making its volume rather over twice as great as that of Sarr. Its mass is also over twice ours, though its average density is a shade less. Surface gravity is one and a quarter Sarr normal. Mean temperature is a little below the freezing point of potassium. Atmospheric pressure uncertain, composition unknown. Period of rotation, one point eight four Sarr days."

"I see. You could duplicate temperature readily enough on this planet, by choosing a point far enough around toward the dark side; and if necessary, there wouldn't be too much trouble in reproducing the periodicity of night and day. Your problem is atmosphere. I'll spend some time thinking out ways and means of getting that, then."

Sallman Ken moved slowly away in the direction of his assigned quarters. His thoughts were not exclusively occupied with the problem of atmosphere analysis; he was thinking more of a mysterious race inhabiting the flat, bleak plains of Planet Three and the possibility of cutting off trade with the planet—always, of

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course, assuming that its mysterious product was what he feared.

He was also wondering if he had overdone his disclaimer of interest in the planet's chief export.

IV.

A circle of three-mile radius has an area of slightly over twenty-eight square miles, or roughly eighteen thousand acres. It follows that the map prepared by Roger and Edith Wing was not as detailed as it might have been. On the other hand, as their father was forced to admit, a tree-covered mountain side does not offer too many details to put on a map; and the effort the children turned in did show every creek and trail of which Mr. Wing had knowledge. Still more to the point, it showed clearly that they had actually traveled over the area in question. This was the defect in the girl's experience which he had wanted corrected before she was released from the "stick-to-the-trail" rule.

He looked up presently from the tattered notebook. The family was gathered around the fireplace again, and the two cartographers were ensconced on either arm of his chair. Don was on the floor between the seats with Billy draped across his neck; Marjorie was in her mother's lap. All were listening for the verdict.

"You seem to have done a pretty good job here," Mr. Wing said at last. "Certainly anyone could find his way around the area with the aid

of this map. Edie, how do you think you could do *without* it?"

"All right, Dad, I'm sure," the girl replied in a slightly surprised tone. "Do I have to?"

Her father shrugged. "You know best whether you want to carry this with you all the time. No, you don't have to, as far as I'm concerned. How have the two of you made out on the patrol schedule?"

Roger took over the conversation, curling a little closer to his father's shoulder and using the map to illustrate his points.

"There are eight trails leading into the three-mile circle at different points. Don and I used to go around the circle each day, going along each one far enough to be sure no one had been using it. There are spots on each which it's practically impossible to go through without leaving some sort of trail. Going from one trail to another we'd try to cut across places of the same sort—where we could tell if people had been through.

"This time we're working it a little differently. I'm still checking the ends of those trails, but we've been listing places from which people could watch anyone bound away from here—there aren't nearly so many of those. Edie can cover nearly all of them in two hour-and-a-half walks morning and afternoon—we've tried it; and I can do the rest when I take the outer trails. That's a lot like the way you've always worked it when you were going out, anyway; you took a zigzag path, and had us checking for

watchers, so that one of us could cut across and warn you if we saw any one—we never have, that I can remember, but I don't suppose that proves anything."

Mr. Wing smiled briefly. "I may be stretching the precautions a little too far," he said. "Still I have certain reasons for not wanting the place I get the metal to become known. Half a dozen of the reasons are in this room with me. Besides, I think you get fun out of it, and I know it keeps you outdoors where you ought to be this time of year. If two or three more of you grow up to be scientists, we may be able to do some work together that will let us forget about secrecy."

The younger girl, who had been displaying increasing signs of indignation during her brother's talk, cut in the instant she thought her father had finished.

"Daddy, I thought I was supposed to be helping with this. I heard Roger say so yesterday, and you said it the first night."

"Oh? And how did you hear what I said that night? As I recall, the matter was not discussed until after you were in bed. What I said then goes—you can go with either Roger or Edie on their walks, but you still observe the limits when you're by yourself. Billy, you too! There'll be plenty of long trips for all of you, without your having to go off on your own, and there's always been plenty to keep you occupied around here. I've been promis-

ing for five or six years to get a load of cement up here if you folks would get enough loose rock together to make a dam out here—I'd like a swimming pool myself. Don doesn't think we need cement for it, but that's something he'll have to prove. I'll be glad if he can do without it, of course." He leaned back and stretched his legs. Billy promptly transferred his perch from Don's shoulders to his father's shirt, and put his own oar into the conversation. He wanted one of the trips before his father went prospecting, and expressed himself at considerable length on the subject. Mr. Wing remained noncommittal until the striking of the clock brought relief. He pulled in his legs abruptly, depositing the youngster on the floor.

"Small fry to bed!" he pronounced solemnly.

"Story!" yelled Margie. "You haven't read since we got here!" Her father pursed his lips.

"How long do you suppose it would take them to be ready for bed?" he asked, as though to himself. There was a flurry of departing legs. Mr. Wing turned to the bookcase beside the fireplace, and encountered the grinning face of his second son. "All right, young man, we need some fun—but some of us need discipline, too. Suppose you and Edie save time by popping upstairs and imitating the excellent example of your juniors!" Still chuckling, the two did so.

For some reason, the story lasted until quite late. The beginning was

vastly exciting, but the pace calmed down later, and Billy and Margie were both carried up to bed at the end—though they refused to believe the fact in the morning.

Roger tried at breakfast to make the small boy tell the end of the story and was surprised when Billy refused to accept his inability to do so as evidence that he had been asleep. The older boy gave up at last and went to saddle the horses; he was constitutionally unfitted to hold his own in an argument where the opponent's only words were "I was not either!"

It was shopping day, and Roger's turn to go down to Clark Fork with his mother to obtain the necessities for the next week. They left as soon after breakfast as the animals could be readied. Edie and the younger children went off on their own; as soon as everyone was away from the house Mr. Wing and Don dressed themselves in hiking clothes and headed east. Roger would have given much to see them go.

The trails were good, and for a couple of hours the two made very satisfactory progress. For the most part they followed the creeks, but once or twice the older man led the way over open spurs of rock which involved considerable climbing.

"This is about the quickest way to the transmitter, Don," he said at one point. "It's a lot closer to the house than even your mother realizes—though goodness knows I wouldn't hide it from her if she

cared to come on one of these hikes. On the regular trips, I follow a very roundabout path I worked out years ago when I was really afraid of being followed. That was just after the first World War, long before I'd even met your mother. There were a number of people around this part of the country then who would cheerfully have tossed me off a hill-top for a fraction of the value I brought back from the first trip. I tell you, I did some pretty serious thinking on the way in from that trip. You'll see why very shortly."

Don made no immediate answer to this. His attention seemed to be fully taken up with negotiating the slope of loose rock they were traversing at the moment. It was a section practically impossible to cross without leaving prominent traces, and he had been a little puzzled at his father's going this way until he realized that the idea was probably to permit a check on any trailers as they returned. Once across the treacherous stuff and angling back down the slope, he finally spoke.

"You said a while back, Dad, that we were the reasons you didn't make public this source of metal. It seems to me that even that shouldn't have carried weight while the war was on—it might have been better to let the government develop the find and use it. I don't mean that I don't appreciate getting a college education, but . . . well—" he paused a little uncomfortably.

"You have a point, Son, and that was another matter for thought

when the war started, with you in high school and Billy just learning to walk. I think I might have done as you suggest, except for the fact that the most probable result of publicity would be to remove the source of metal. Just be patient a little longer—we'll be there in a few minutes, and you will see for yourself."

Donald nodded acceptance of this, and they proceeded in silence for a short time. The course Mr. Wing was following had led them into a narrow gully after crossing the scree; now he turned up this, making his way easily along the bank of the tiny brook which flowed down its center. After some ten minutes' climb the trees began to thin out, and a few more rods found them on practically bare rock. This extended for some distance above them, but the older man seemed to have no desire to get to the top of the hill.

Instead, he turned again, moving quickly across the bare rock as though a path were plainly marked before him; and in a few steps reached the edge of a shallow declivity which appeared to have acted as a catch basin for rocks which had rolled from farther up the hill. Winding his way among these, with Donald close at his heels, he finally stopped and moved to one side, permitting his son to see what lay before them.

It was an almost featureless structure of metal, roughly cubical in shape and a little less than a yard on

each edge. There was a small opening on one side, containing a single projection which had the appearance of a toggle switch. Several bolt heads of quite conventional appearance were also visible on different parts of the surface.

After allowing his son to look the object over for a few moments, Mr. Wing took a small screwdriver from his pocket and set to work on the bolts, which seemed very loose. Don, lacking tools, tried a few of the projecting heads with his fingers and had little difficulty with them; in two or three minutes, the older man was able to remove several metal plates and expose the interior of the block to view. Don looked, and whistled.

"What is it, Dad? Not an ordinary radio, certainly!"

"No. It seems to be a radio of some sort, however. I don't know what sort of wave it uses, or its range, or its power source—though I have some ideas about the last two. There's nothing to using it; I imagine the makers wanted that to be easy, and there is only the single control switch. I'm not so sure that the interior was meant to be so accessible."

"But where did it come from? Who made it? How did you get hold of it?"

"That's a rather long story, and happened, as I said, before you were born."

"I was just out of college, and had got interested in this part of the country; so I decided to see some of

it first hand, and eventually found myself here in the hills. I started at Helena, and went on foot up to Flathead, through Glacier Park, west along the border to the Kootenai, and back along the river past Bonner's Ferry into the Cabinets. It wasn't a very exciting jaunt, but I saw a lot and had a pretty good time.

"I was crossing the brook we just followed up here, just after I had got under way one morning, when I heard the weirdest racket from up the hill. I really didn't know too much about the neighborhood, and was a bit on the uneasy side; but I had a rifle, and managed to convince myself that I was out to satisfy my curiosity, so I headed up toward the noise.

"When I got out from among the trees, the noise began to sound more and more like spoken language; so I yelled a few words myself, though I couldn't understand a word of it. There was no answer at first—just this tremendous, roaring voice blating out the strangely regular sounds. Finally, a little way up the hill from here, on a rather open spot, I saw the source; and at almost the same instant the noise stopped.

"Lying out in the open, where it could be seen from any direction, was a thing that looked like a perfectly good submarine torpedo—everyone was familiar with those at the time, as they played a very prominent part in the first World War. Science-fiction had not come into style then, and Heaven knows I



wasn't much of a physical scientist, but even so I found it hard to believe that the thing had been carried there. I examined it as thoroughly as I could, and found a few discrepancies in the torpedo theory.

"In the first place, it had neither propellers nor any type of steering fin. It was about twenty feet long and three in diameter, which was reasonable for a torpedo as far as I knew, but the only break in the surface was a section of the side, near what I supposed to be the front, which was open rather like a bomb bay. I looked in, though I didn't take a chance on sticking an arm or my head inside, and saw a chamber that occupied most of the interior of the nose section. It was empty, except for a noticeable smell of burning sulfur.

"I nearly had a heart attack when the thing began talking again, this time in a much lower tone—at any rate I jumped two feet. Then I cursed it out in every language I knew for startling me so. It took me a minute or two to get command of myself, and then I realized that the sounds it was making were rather clumsy imitations of my own words. To make sure, I tried some others, one word at a time; and most of them were repeated with fair accuracy. Whoever was speaking couldn't pronounce 'P' or 'B,' but got on fairly well with the rest.

"Obviously there was either someone trapped in the rear of the torpedo, or it contained a radio and some-

one was calling from a distance. I doubted the first, because of the tremendous volume behind the original sounds; and presently there was further evidence.

"I had determined to set up camp right there, early as it was. I was going about the business, saying an occasional word to the torpedo and being boomed at in return, when another of the things appeared overhead. It spoke, rather softly, when it was still some distance up—apparently the controllers didn't want to scare me away! It settled beside the first, trailing a thin cloud of blue smoke which I thought at first must have to do with driving rockets. However, it proved to be leaking around the edges of a door similar to that in the first torpedo, and then a big cloud of it puffed out as the door opened. That made me a little cautious, which was just as well—the metal turned out to be hot enough to feel the radiation five feet away. How much hotter it had been before I can't guess. The sulfur smell was strong for a while after the second torpedo landed, but gradually faded out again.

"I had to wait a while before the thing was cool enough to approach with comfort. When I did, I found that the nose compartment this time was not empty. There was an affair rather like a fishing-box inside, with the compartments of one side full of junk and those on the other empty. I finally took a chance on reaching in for it, once it was cool enough to touch.

"When I got it out in the sunlight, I found that the full compartments were covered with little glassy lids, which were latched shut; and there was a tricky connection between the two sides which made it necessary to put something in an empty compartment and close its lid before you could open the corresponding one on the other side. There were only half a dozen spaces, so I fished out some junk of my own—a wad of paper from my notebook, a chunk of granite, a cigarette, some lichen from the rocks around, and so on—and cleaned out the full compartments. One of the things was a lump of platinum and related metals that must have weighed two pounds.

"Right then I settled down to some serious thinking. In the first place, the torpedo came from off this planet. The only spaceship I'd ever heard of was the projectile in Jules Verne's story, but people of this planet don't send flying torpedoes with no visible means of propulsion carrying nuggets of what I knew even then was a valuable metal; and if they do, they don't call attention to the practice by broadcasting weird languages loudly enough to be heard a mile away.

"Granting that the torpedo came from outer space, its behavior seemed to indicate only one thing—its senders wanted to trade. At any rate, that was the theory I decided to act on. I put all the junk except the platinum nugget back where it came from, and put the box back in the nose of the torpedo. I don't yet

know if they could see me or not—I rather doubt it, for a number of reasons—but the door closed almost at once and the thing took off—straight up, out of sight. I was sorry I hadn't had much of value to stuff in my side of the box. I had thought of sending them a rifle cartridge to indicate we had a mechanical industry, but remembered the temperature at which the thing had arrived and decided against it.

"It took two or three hours for the torpedo to make its round trip. I had set up my tent and rounded up some firewood and water by the time it came back, and I found out my guess was right. This time they had put another platinum nugget in one compartment, leaving the others empty; and I was able to remember what I had put in the corresponding space on the previous visit.

"That about tells the story." Mr. Wing grinned at his son. "I've been swapping cigarettes for platinum and iridium nuggets for about thirty years now—and you can see why I wanted you to study some astronomy!"

Don whistled gently. "I guess I do, at that. But you haven't explained this," he indicated the metal cube on which his father was sitting.

"That came down a little later, grappled to a torpedo, and the original one took off immediately afterwards. I have always supposed they use it to find this spot again. We've sort of fallen into a schedule over the years. I'm never here in the

winter any more, and they seem to realize that; but from two to three days after I snap this switch off and on a few times, like this"—he demonstrated—"the exchequer gets a shot in the arm."

Don frowned thoughtfully, and was silent for a time.

"I still don't see why you keep it a secret," he said at last. "If the affair is really interplanetary, it's tremendously important."

"That's true, of course. However, if these people wanted contact with mankind in general, they could certainly establish it without any difficulty. It has always seemed to me that their maintaining contact in this fashion was evidence that they did not want their presence generally known; so that if experts began taking their transmitter apart, for example, or sending literature and machinery out to them in an effort to show our state of civilization, they would simply leave."

"That seems a little farfetched."

"Perhaps; but can you offer a better suggestion why they don't land one of these things in a city? They're paying tremendous prices for darned small quantities of tobacco—and a corner drugstore could stock them for years at their rate of consumption.

"Don't get me wrong, Son; I certainly appreciate the importance of all this, and want very much to find out all I can about these things and their machines; but I want the investigating done by people whom I can trust to be careful not to upset

the apple cart. I wish the whole family were seven or eight years older; we'd have a good research team right here. For the moment, though, you and I—principally you—are going to have to do the investigating, while Roger and Edie do the scouting. I expect they'll sneak over to watch us, of course; Roger's curiosity is starting to keep him awake nights, and he has the makings of a man of action. I'm wondering whether we don't find his tracks or Edie's on the way back—he might have persuaded her to go to town for him. There's nothing more to be done here, unless you want to look this communicator over more closely; we might as well head back, and find out how enterprising the younger generation is."

"There's no hurry, Dad. I'd like to look this thing over for a while. It has some of the earmarks of a short-wave transmitter, but there are a lot of things I'd like to get straight."

"Me, too. I've learned a good deal about radios in the last twenty years, but it's a bit beyond me. Of course, I've never dared take off more than the outer casing; there are parts too deeply stowed to be visible, which might be highly informative if we could see them."

"Exactly what I was thinking. There should be some way to look into it—we ought to dig up one of those dentist's mirrors."

"You don't catch me sticking anything made of metal into a gadget

that almost certainly uses astronomical voltages."

"Well . . . I suppose not. We could turn it off first, if we were sure which position of that switch were 'off.' We don't really know whether you're calling them with a short transmission when you move it, or whether you're breaking a continuous one. If they use it for homing, it would be the latter; but we can't be sure."

"Even if we were, turning it off wouldn't be enough. Condensers can hold a nasty bite for a long time."

Don admitted the justice of this point, and spent only a few minutes peering through the openings left by the removal of the plates.

"Most of the inside seems to be blocks of bakelite anyway," he said at last. "I suppose they have everything sealed in for permanence. I wonder how they expect to service it? I guess you're right—we may as well go home until the torpedo comes." He slung the pack that had contained their lunch—or rather, the sandwiches they had eaten en route—over his shoulder, and straightened up. His father nodded in agreement, and they began to retrace their steps down the hillside.

Don was wrapped in thought, and his father forbore to interrupt. He knew how he had reacted to the events he had just described, when he had been very little older than his son was now; also, he had a high opinion of his children's intelligence, and believed firmly in letting them solve problems for themselves

as much as was safe. He reflected somewhat ruefully that nothing he could say would be too much help, in any case.

There was no trace of anyone's having followed them at any point on the trail home, though they split up to take opposite sides of the scree they had deliberately crossed on the way out. Neither found this very surprising, for it turned out that Edith had made her scheduled patrols and spent the rest of the day with the younger children, while Roger had gone to town as expected. If he had thought of finding a substitute and following his father, nothing had come of it. Mr. Wing was not sure whether he ought to be pleased or disappointed.

V.

Laj Drai found his hired school-teacher beside one of the torpedoes, checking off its contents with loops of one tentacle. The mechanic was listening as he named off the items.

"Magnesium cell; titanium cell; sodium . . . oh, hello, Drai. Anything going on?"

"Hard to say. You are setting up a research project, I take it?"

"Just checking some hypotheses. I've listed all the elements that would be gaseous under the conditions of Planet Three, and as many compounds as I could find in the Tables. Some are a little doubtful, since I have no pressure data; they might be liquid. Still, if they are there in any quantity, their va-

pors should be present.

"Then I eliminated as many as possible on theoretical grounds, since I can't test for everything at once."

"Theoretical grounds?"

"Yes. For example, while fluorine is still gaseous under those conditions, it's much too active to be expected in the free state. The same is true of chlorine—which may be liquid—and oxygen. On the other hand, hydrogen seems very likely, along with hydrogen sulfide and other volatile compounds of both these elements. Nitrogen should be present, and the inert gases—though I don't know how I can test for those.

"I've built little cells containing various materials, along with built-in heaters; and I'm going to warm them up one at a time after landing this torpedo and opening it to the atmosphere. Then I'll bring it back and see what the air did to my samples. I have magnesium and titanium, which should detect the nitrogen, and sodium, and a couple of sulfides which should be reduced if there's much hydrogen, and so on. The report may not be complete, but we should learn something."

"So I should say, from what little I know about it. Were you planning to send the torpedo out right away?"

"Yes; everything seems to be ready, unless there are complications from your department."

"Nothing much. We were just going to send one out ourselves; our

native signaled a short time ago."

"Can you control two torpedoes at once?"

"Yes, easily. It occurs to me, however, that it might be best for you to keep a mile or two away from our homing station, and make your descent when that part of the planet is in darkness. The natives are diurnal, we are sure; and it would be a pity to scare them off if any of your chemical reactions are bright or noisy or smelly."

"Or affect some sense we don't know about. All right, you have a good point. Do you want me to wait until you have finished your trading, or go ahead of you if the chance occurs?"

"I don't see that it matters much. I don't remember whether it will be night or day there when the torpedoes arrive overhead; there's a table for figuring it up in the office, and we'll check before arrival time. I'd say if it was day, we'd go right down while you waited, and if it's night you get first shot."

"All right with me."

"You'll have to control from down here—there's only one unit up in the observatory. It won't matter, since you'll be working blind anyway. I'll go up and tell them that you're operating too—we have a relay unit with detection apparatus circling the planet now, and there's no point in having the observers think the flatlanders are out in space."

"Have you been getting activity from them?"

"Not much. Within the last three

or four years we have picked up some radiation suspiciously like radar, but it's all been constant frequency so far. We put quarter-wave coatings of plastic with a half-reflecting film of metal on all the torpedoes, and haven't had any trouble. They only use a dozen different frequencies, and we're set up for all of them—when they change, we simply use another drone. I suppose they'll start using two or more wave lengths in one area or maybe frequency modulation eventually, and we'll have to get a non-reflective coating. That would be simpler anyway—only it's more expensive. I learned that when I had the *Karela* coated. I wonder how we'll get around it if they learn to pick up infrared? The torps are enough hotter than the planet to show up like novae, when we happen to start them from the ship just outside the atmosphere."

"Let 'em hang in space until they cool off," Ken and the mechanic replied in chorus. "Or send them all from here, as we've been doing," added the latter.

Laj Drai left without further remark.

"That fellow needs a whole scientific college," the mechanic remarked as the door closed. "He's so darned suspicious he'll hire only one man at a time, and usually fires them before long."

"Then I'm not the first?"

"You're the first to get this far. There were a couple of others, and

he got the idea they were poking into his business, so I never even found out what ideas they had. I'm no scientist, but I'm curious—let's get his iron crate into space before he changes his mind about letting it go."

Ken gestured agreement, but hung back as the mechanic cut the test controller into the main outside beam circuit—two multiphase signals could be handled as easily as one on the beam, and both torpedoes would be close enough together so that one beam would suffice. The mechanic's information was interesting; it had never occurred to him that others might have preceded him on this job. In a way, that was good—the others had presumably not been narcotics agents, or Rade would have told him. Therefore he had better protective coloration than he had supposed. Draï might even be getting used to having outsiders connected with his project.

But just what did this mechanic know? After all, he had apparently been around for some time, and Draï was certainly not afraid to talk in his presence. Perhaps he might be worked up into a really effective source of information; on the other hand, it might be dangerous to try—quite conceivably one of his minor duties was keeping a watchful eye on Sallman Ken's behavior. He was a rather taciturn individual and Ken had not given him much attention so far.

At the moment he was all tech-

nician. He was draped over the rack in front of the control board, his tentacles resting on the various toggles and verniers, and a rising hum indicated that the tubes were warming. After a moment, he twisted a vernier knob slightly, and the torpedo on which Ken had been working lifted gently from the cradle. He spoke without turning his eyes backward:

"If you'll go to the far end of the room, I'll run it down there and we can test the microphone and speaker. I know you don't plan to use them, but we might as well have them serviceable."

Ken followed the suggestion, testing first the sound apparatus and then the various recorders and other instruments in the cargo chamber which were intended to tell whether or not any violent chemical reactions took place—photocells and pyrometers, and gas pumps connected to sample flasks and precipitators. Everything appeared in working order and was firmly clamped in place.

Assured of this, the operator guided the little vessel to a tunnel-like air lock in one wall of the room, maneuvered it in, pumped back the air, and drove the torpedo out into the vacuum of Mercury's surface. Without further ado he sent it hurtling away from the planet, its control keyed in with a master achronic beam running from the station to the relay unit near Earth. No further attention would be needed until it approached the planet.

The mechanic rose from in front of the panel, and turned to Ken.

"I'm going to sleep for a while," he said. "I'll be back before arrival time. In case you care, you'll be making the first landing. It takes one and a half revolutions of Planet Three, more or less, to get the torpedo there when the planets are in their present relative positions—we can't use overdrive on the drones—and the signal must have come during the local daytime. I'll see you. Have me paged if you want me for anything."

Ken gave the equivalent of an affirmative nod.

"All right—and thanks. Your name is Allmer, isn't it?"

"Right—Feth Allmer."

Without further speech the mechanic disappeared through the door, moving with the fluid ease of a person well accustomed to Mercury's feeble gravity, and leaving Sallman Ken in a very thoughtful mood behind him.

Almost unconsciously the investigator settled onto the rack deserted by Allmer, and stared blankly at the indicators in front of him. One of his troubles, he reflected ruefully, was his tendency to get interested in two problems at once. In one way, that might be good, of course; the genuine absorption in the problem of Planet Three was the best possible guard against suspicion of his other job; but it didn't help him to concentrate on that other. For hours now he had thought of practi-

cally nothing but his test project, until Allmer's parting remarks had jarred him back to duty.

He had assumed Allmer was a competent technician, but somehow he had not expected the acuity the elderly fellow had just displayed. Ken himself had missed the implication of Drai's statement concerning the habits of the natives of the third planet; apparently Drai had not even thought of doing his own reasoning.

But could he be that stupid? He, unlike Ken, knew the distances involved in a flight to that world, and the speed of the torpedoes; he had, on his own word, been trading here for years. What purpose could he have in trying to appear more stupid than he really was?

One possibility certainly existed. Ken might already be under suspicion, and facing a conspiracy to make him betray himself by overconfidence. Still, why in that case had the mechanic betrayed his own intelligence? Perhaps he was building himself up as a possible confidant, in case Ken were to grow communicative. If that were so, Feth was his greatest danger, since he was most in Ken's company and in best position to serve as a spy. On the other hand, the fellow might be completely innocent even if the group as a whole were engaged in smuggling, and his recent words might have been motivated by a sincere desire to be helpful. There seemed no way of telling at the moment which of these possibilities was

the more likely; Ken gave the problem up for the moment as insoluble with the data on hand.

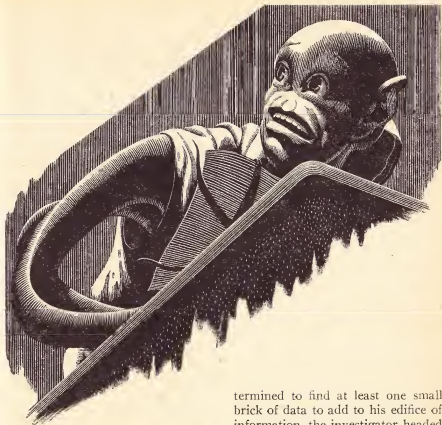
The other problem was demanding his attention, anyway. Some of the indicators on the board in front of him were fluctuating. He had learned the panel fairly well in the last day or two, and was able to interpret the readings himself. It seemed, he noted, that pressure and temperature were both going down in the cargo chamber of the projectile. Well, that was reasonable. There were no heaters working, and the pressure would naturally drop as the gas cooled. Then it occurred to him that the temperature of Planet Three was low enough to freeze sulfur, and his test units would be covered with a crust of the stuff. Something should be done about that.

As a matter of fact, most of the pressure drop was due to leakage; the cargo door had cooled and contracted sufficiently to let air escape slowly around its edges. Ken, however, did not think of that; he found the appropriate switch and tripped it, watching the pressure drop instantly to zero as the door opened. The temperature was almost unaffected—if anything, it dropped more slowly, for the recording pyrometers were now insulated by a vacuum and the expansion of the gaseous sulfur into empty space had had no cooling effect to speak of. A touch on some of the switches which were designed to heat the test

substances showed that the little furnaces were still in working order, and after a moment's thought Ken allowed the magnesium and titanium specimens to come up to melting temperature. Then, sure that they were as free of contaminating gases as could be managed, he watched the recorders as the samples cooled again. Through all this, the torpedo hurtled on, unaffected by the extra drain on its power.

For some minutes Ken continued to wait, one eye roving over the dials and the other glancing casually about the great room; but finally he decided that Allmer had picked a good time to go off duty. He did not feel tired himself, but gradually he became convinced that there must be something a little more constructive to do. He suspected that, even if there were to be any drugs around the station, they would not have arrived yet, so there was no use making a search for them; but preparations might be made to see just what came back in the other torpedo.

As a first step, it might be well to go up to the observatory to find out just who was guiding that missile. If it were Drai himself, it would be a point in favor of Rade; if not, it would be another person from whom information might be obtained. There seemed little doubt that no one would be allowed to run the trading torpedo who did not know exactly what was being obtained on the third planet—the Planet of Ice, as Ken was coming to



think of it—not that he thought of ice as a substance; he had never seen the material and would have thought of it as hydrogen oxide in any case. Planet of Solid Sulfur comes closer to the way he would have expressed the thought.

Ken was basing his supposition on his memory of how Draï had refrained from naming the substance obtained from the planet; and, de-

termined to find at least one small brick of data to add to his edifice of information, the investigator headed up the spiral ramp toward the observatory at the station's highest level. No one attempted to stop him on the way, though he met a couple of workers who flipped tentacles in casual recognition. The door of the observatory was not locked, as a trial push showed, and he entered, still without opposition. He was braced for a prompt request to depart, and was a little surprised when nothing at all was said. A moment later, when his eyes had become ac-

customed to the dimness of the big room, he realized to his chagrin that no one was there.

"No business secrets loose so far," he muttered.

He was about to return the way he had come, when it occurred to him that he might as well make sure of that fact. There were not many places where paper work of any sort could be kept, at least at first glance; and these he rapidly covered. They were mostly cabinets built under instrument panels, and seemed to contain nothing but tables of the motions of the planets of this system. These seemed rather valueless; their most probable use would be in navigation, and Ken could not imagine anyone's wanting to navigate anywhere in this system except to the World of Ice. They could also be used to direct the instruments, if anyone wanted to look at the planets in question; but that seemed even less helpful.

Under the beam-setting controls was a small drawer which also contained two sets of numbers—again, spatial co-ordinates; but this time Ken froze to attention as he realized that one set at least did not refer to planets—they contained no cyclic term. The set was short, consisting of six groups of numbers containing from six to ten digits each; but he *recognized* them. The first identified by spectrum a beacon star; the next three were direction cosines, giving the three-dimensional bearing to another sun; the fifth gave a

distance. Normally he might not have recognized or remembered the lengthy figures; but those were the co-ordinates of the blazing A-class sun which warmed Sarr, his home planet. The final number was another range; and beyond question it represented the distance from the present point of observation to the listed star. Ken knew enough of the standard navigational notations to be sure of that.

The other set of numbers, then, must give the direction of the same sun relative to some local set of co-ordinates; and not only was he ignorant of the co-ordinates, but the numbers were too long to remember. To copy them would be suicide, if anything more than commercial secrecy were involved. For long minutes Sallman Ken stood frozen in thought; then, abruptly, he slipped the sheet back into the drawer, closed the latter, and as quickly as was compatible with caution left the observatory.

Since the information was there, it would not do for anyone to get the idea he had been there for any great length of time. It would be better if no one knew he had been there at all, but he had been seen on the way up the ramp. He proceeded to get back to his own quarters and assume an attitude of repose, though his mind still raced furiously.

He knew his distance from home. Evidently the twenty-two days of the journey to this system had not been spent in straight-line flight; the dis-

tance was only two hundred twelve parsecs. Score one for Rade; that would be an expensive business precaution, but a normal criminal one.

The direction home *from* this system he did not know. It did not matter too much anyway; what the Narcotics Bureau would want would be the opposite direction, on Galactic co-ordinates, and there would be no mathematical connection between the two except a purely arbitrary formula which would be harder to memorize than the direction itself.

Of course, the beacon listed in the stellar co-ordinates was probably visible from here; but could he recognize it with any certainty without instruments? The instruments were available, of course, but it might not be wise to be caught using them. No, orientation was definitely the last job to be accomplished in his present location.

At any rate, one fact had been learned and one point of probability had been added to the Rade theory. Sallman Ken decided that made a good day's work, and allowed himself to relax on the strength of it.

VI.

Nearly three of Sarr's thirteen-hour days passed uneventfully before the relay station circling Earth picked up the approaching torpedoes. As Feth Allmer had predicted—and Laj Draï had confirmed, after checking with his tables—the sig-

nals from the planted homing unit were coming from the dark side of the planet. Draï phoned down from the observatory to the shop, where Ken and Allmer were engaged in decelerating their missile.

"You may as well drop straight down as soon as you swing around to the dark side," he said. "You will pick up the beacon if you spiral in, keeping between forty and fifty-five degrees above the plane of the planet's orbit, measured from the planet's center. The beam can be picked up by your torpedo more than forty diameters out,* so you can't possibly miss it. You'd better ride the beam down automatically until you're into atmosphere, then go manual and move off a couple of miles if you plan to go all the way to the ground. If the natives are camping near the beam transmitter, it would be a pity to touch off your chemicals right in their midst."

"True enough," Ken replied. "Feth is swinging around into the shadows now, still about five diameters out. I wish there were a vision transmitter in that machine. Some time I'm going down close enough to use a telescope, unless someone builds a TV that will stand winter weather."

"You'll get worse than frostbite," Draï responded sincerely. "The time you were really looking at that world, you didn't seem quite so anxious to get close to it."

"I hadn't got curious then," responded Ken.

The conversation lapsed for a

while, as Feth Allmer slowly spun the verniers controlling the direction of thrust from the torpedo's drivers. The machine was, as Ken had said, cutting around into the shadow of the big planet, still with a relative speed of several miles per second to overcome. Allmer was navigating with the aid of a response-timer and directional loop in the relay station, whose readings were being reproduced on his own board; the torpedo was still too far from Earth for its reflection altimeter to be effective.

For some minutes Ken watched silently, interpreting as best he could the motions of the flickering needles and deft tentacles. A grunt of satisfaction from the operator finally told him more clearly than the instruments that the beam had been reached; a snaky arm promptly twisted one of the verniers as far as it would go.

"I don't see why they couldn't power these things for decent acceleration," Feth's voice came in an undertone. "How much do you want to bet that we don't run all the way through the beam before I can match the planet's rotation? With nine-tenths of their space free for drivers and accumulators, you'd think they could pile up speed even without overdrive. These cheap—" his voice trailed off again.

Ken made no reply, not being sure whether one was expected. Anyway, Allmer was too bright for his utterances to be spontaneous, and any answer should be carefully

considered purely from motives of caution.

Apparently the mechanic had been unduly pessimistic; for in a matter of minutes he had succeeded in fighting the torpedo into a vertical descent. Even Ken was able to read this from the indicators; and before long the reflection altimeter began to register. This device was effective at a distance equal to Sarr's diameter—a trifle over six thousand miles—and Ken settled himself beside the operator as soon as he noted its reaction. There was not far to go.

His own particular bank of instruments, installed on a makeshift panel of their own by Allmer, were still idle. The pressures indicated zero, and the temperatures were low—even the sodium had frozen, apparently. There had been little change for many hours—apparently the whole projectile was nearly in radiative equilibrium with the distant sun. Ken watched tensely as the altimeter reading dropped, wondering slightly whether atmosphere would first make itself apparent through temperature or pressure readings.

As a matter of fact, he did not find out. Feth reported pressure first, before any of Ken's indicators had responded; and the investigator remembered that the door was shut. It had leaked before, of course, but that had been under a considerably greater pressure differential; apparently the space around the door was fairly tight, even at the temperature

now indicated.

"Open the cargo door, please," Ken responded to the report. "We might as well find out if anything is going to react spontaneously."

"Just a minute; I'm still descending pretty fast. If the air is very dense, I could tear the doors off at this speed."

"Can't you decelerate faster?"

"Yes, now. Just a moment. I didn't want to take all night on the drop, but there's only about twenty miles to go now. You're the boss from here in."

The needle of the altimeter obediently slowed in its march around the dial. Ken began warming up the titanium sample—it had the highest melting point of all. In addition, he was reasonably sure that there would be free nitrogen in the atmosphere; and at least one of the tests ought to work.

At five miles above the ground, the little furnace was glowing white hot, judging from the amount of light striking the photocell inside the nose compartment. Atmospheric pressure was quite measurable, though far from sufficient from the Sarrian point of view, if the Bourdon gauge could be trusted; and Feth claimed to have worked out a correction table by calibrating several of them on the dark side of Planet One.

"Can you hold it at this height for a while?" Ken asked. "I'm going to let this titanium act up here, if I possibly can. There's atmosphere, and we're high enough not to be

visible, I should think." Allmer gestured to the reading of the photocell.

"The door is open, and that furnace is shining pretty brightly. You'd do better to shut the door, only that would keep air pretty well out. A light like that so far from the ground must show for scores of miles."

"I never thought of that." Ken was a trifle startled. He thought for a moment, then, "Well, let's close the door anyway. We have a pressure reading. If that drops, we'll know that some sort of action is taking place."

"True enough." Allmer snapped the toggle closing the door and waited silently while Ken manipulated his controls.

Deprived of the opening through which a good deal of heat had been radiating, the compartment temperature began to climb. By rights, the pressure should have done the same; but to Ken's intense satisfaction, it did not—it fell, instead. At his request, the door was opened for an instant and promptly closed again; results were consistent. The pressure popped back to its former value, then fell off once more. Apparently the titanium was combining with some gaseous component of the surrounding atmosphere, though not violently enough for the reaction to be called combustion.

"If you're far enough to one side of the beam, let's go down to the surface," the investigator finally said.

"I'd like to find out what percentage of the air will react this way, and for any sort of accuracy I'll need all the atmospheric pressure I can get to start with."

Feth Allmer gave the equivalent of a nod.

"We're a couple of miles to one side," he said. "I can drop straight down whenever you want. Do you want the door open or closed?"

"Closed. I'll let the sample cool a little, so we can get normal pressure after landing without using it all up. Then I'll warm it up again, and see how much of the air in the compartment is used up."

Feth gestured agreement, and a faint whistling became audible as the torpedo began to fall without power—like the others, it had speaker and sound pickups, which Allmer had not bothered to remove. Four miles—three—two—one—with deceptive casualness, the mechanic checked the plunge with a reading of one hundred fifty feet on the altimeter, and eased it very cautiously downward. As he did so, he gestured with one tentacle at another dial; and Ken, after a moment, understood. The projectile was already below the level of the homing station.

"I suppose the transmitter is on a mountain, and we're letting down into a valley," Feth elaborated, without taking his eyes from his work.

"Reasonable enough—this was always supposed to be a rough section of the planet," agreed Ken. "It's good—there's that much less

chance of being visible from a distance. What's the matter—aren't you down, after all?"

The altimeter had reached zero, but nothing had checked the descent. Faint rustlings had become audible in the last few seconds, and now these were supplemented by louder snappings and cracklings. Descent ceased for a moment. Apparently an obstacle sufficient to reflect radar waves and take the machine's weight had been encountered; but when a little downward drive was applied, the crackling progress continued for some distance. Finally, however, it ceased—noise and motion alike—even when Allmer doubled and quadrupled the power for several seconds. He opened his drive switches and turned to Ken with a gesture equivalent to a shrug.

"We seem to be down, though I can't guarantee it's ground as we know it. It seems to be as low as we can get, though. There's the door switch, in case you didn't know. You're on your own, unless you don't mind my hanging around to watch. I suppose the boss will be here soon, too; he should have his machine in an orbit by this time."

"Sure—stick around. I'll be glad to have you. Maybe we'll have to move the thing around, for all I can tell at the moment." He had opened the door as he spoke, and watched with interest as the pressure gauge snapped up to a value about two thirds of Sarr normal. At the same instant, the temperature dial of the

still hot titanium furnace began to rise spontaneously—apparently the greater atmospheric density was more than able to offset the slight amount of cooling that had taken place; the metal was actually burning. Ken hastily shut the door.

The temperature continued to rise a short distance, while the light intensity in the cargo compartment of the torpedo held at a value that would have been intense even to eyes accustomed to Sarr's fervent sun. The most interesting information, however, came from the pressure gauge; and it was on this that Ken kept his attention glued.

For perhaps twenty seconds the reaction continued unabated; then it began to die out, and in ten more the temperature began once more to drop. The reason was evident; pressure had dropped to less than two per cent of its former value. There was literally nothing left to carry on the reaction.

Ken emitted the booming drone from his sound-diaphragm that was the Sarrian equivalent of a whistle of surprise.

"I knew molten titanium would react to completion in our atmosphere, but I didn't think it would possibly do it here. I guess I was wrong—I was rather expecting a mixture of compounds, whose heats of formation would prevent any such reaction. Still, I suppose at this planet's temperature, they wouldn't have to be very stable from our point of view—" his voice trailed off.

"Means nothing to me, but it certainly burned," Feth Allmer remarked. "How about your other samples? Are you going to run them off right away, or wait for things to cool down again to planet-normal?" Another dial caught Ken's eye before he could answer.

"Hey—who lit the sodium?" he asked, heedless of Allmer's query. "It's cooling now, but it must have been burning, too, for a while when there was air."

"Let more in and see." The toggle snapped over, and there was a distinct popping sound as air rushed into the rear-vacuum. The sodium continued to cool.

"Maybe a spark from the titanium pot lighted it up." Without answering, Ken closed the door once more and began to warm up the sodium container. Apparently Feth's suggestion was not too far from the mark; very little additional heat was needed to ignite the metal. This time the reaction stopped after pressure had dropped about a sixth. Then the door was opened again, and another touch of artificial heat caused the reaction to resume. This time it continued, presumably, until the sodium was consumed.

"I want enough material to work on when we get it back," Ken explained. "I'm not the best analytical chemist."

The crucible of carbon dust gave decidedly peculiar results. *Something* certainly happened, for the material not only maintained but even increased its temperature for

some time after the heating current was cut off; but there was no evidence either of consumption or production of gas in the closed chamber. Both Ken and Feth were slightly startled. The former, in response to the mechanic's quizzical expression, admitted the fact was probably significant but could offer no explanation.

Samples of iron, tin, lead, and gold followed in due course. None of these seemed greatly affected by the peculiar atmosphere at any temperature, with the possible exception of the iron; there the pressure drop was too small to be certain, since in each of these cases the heating had caused an increase in pressure which had to be allowed for. Magnesium behaved remarkably like sodium, except that it burned even more brightly than the titanium.

Here again Ken decided to finish off the metal by relighting it with the door open; and here the testing program received a sudden interruption.

Both Sarrians were perfectly aware that with the door open a beam of light must be stabbing out into the darkness. Both had ceased to worry about the fact; it had been equally true, though perhaps the radiance was fainter, with the blazing sodium and almost as much so when the sheer heat of the samples of iron and gold had been exposed. They had completely ceased to worry about being seen; a full hour had already passed since they had landed

the torpedo, owing to the cooling periods necessary between tests, and there had been no sign that any attention had been attracted. Ken should have remembered the difficulty that had been encountered in reaching the ground.

The possibility was brought back to their attention with the relighting of the magnesium sample. As the photocell reported the re-establishment of combustion, a shrill sound erupted from the speaker above the control board and echoed through the shop. Neither had to be told what it was; both had heard the recordings of the voice of the Third Planet native who had found the original torpedo.

For an instant both remained frozen on their tracks, exploring mentally the possibilities of the situation. Feth made a tentative gesture toward the power switches, only to be checked by an imperious snap of Ken's tentacles.

"Wait! Is our speaker on?" The words were whispered.

"Yes." Feth pulled a microphone down to chest level and retreated a step. He wanted no part in what Ken seemed about to do.

Sallman himself, however, had once more become completely absorbed in the mystery of the World of Ice, to the exclusion of all other matters; he saw no reason for leaving the site where his activities had been discovered. It never occurred to him not to answer the native who appeared to have made the discov-

ery. With his speaking diaphragm close to the microphone, he emulated the "boss" of so many years before, and tried to imitate the sounds coming from the speaker.

The result was utter silence.

At first neither listener worried; the native would naturally be surprised. Gradually, however, an expression of mild anxiety began to appear on Ken's features, while an "I-told-you-so" air became manifest about Feth.

"You've scared him away," the latter finally said. "If his tribe stampedes with him, Drai won't be very happy about it."

A faint crackling which had preceded the alien's call, and which his concentration of chemical problems had prevented reaching Ken's conscious mind, suddenly ballooned into recollection, and he snatched at the straw.

"But we heard him coming—the same sort of noise the torpedo made landing—and we haven't heard him leave. He must still be waiting."

"Heard him coming? Oh . . . that? How do you know that's what it was? Neither of us was paying any attention."

"What else could it have been?" This was a decidedly unfair question, to which Feth attempted no direct answer. He simply countered with another.

"What's he waiting for, then?" Fate was unkind to him; Ken was spared the necessity of answering.

The human voice came again, less shrill this time; history seemed

to be repeating itself. Ken listened intently; Feth seemed to have forgotten his intention of dissociating himself from the proceedings and was crowded as close as the detective to the speaker. The voice went on, in short bursts which required little imagination to interpret as questions. Not a word was understandable, though both thought they recognized the human "no" on several occasions. Certainly the creature did not utter any of the names that the Sarrians had come to associate with trade items—Feth, who knew them all, was writing them on a scrap of paper. Ken finally grew impatient, took the list from the mechanic, and began to pronounce them as well as he could, pausing after each.

"Iridium—Platinum—Gold—Osmium—"

"Gold!" the unseen speaker cut in.

"Gold!" responded Ken intelligently, into the microphone, and "Which one is that?" in a hasty aside to Feth. The mechanic told him, also in a whisper. "There's a sample in the torpedo. We can't trade it off—I want to analyze it for traces of corrosion. Anyway it was melted a little while ago, and he'll never get it out of the crucible. What's the name for the stuff you get from them?"

"Tofacco." Feth answered without thinking—but he started thinking immediately afterward. He remembered Drai's promise of the fate of anyone who gave Ken infor-

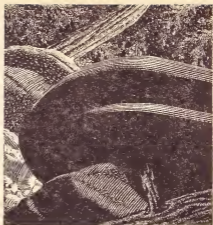
mation about "the stuff" obtained from Earth, and knew rather better than Sallman just how jocular Laj was likely to be. The memory made him itch, as though his hide were already coming loose. He wondered how he could keep news of his slip from reaching the higher levels, but had no time to get a really constructive idea. The speaker interrupted him again.

If the previous calls had been loud, this was explosive. The creature must have had his vocal apparatus within inches of the torpedo's microphone, and been using full voice power to boot. The roar echoed for seconds through the shop and almost drowned out the clanking which followed—a sound which suggested something hard striking the hull of the torpedo. The native, for some reason, seemed to have become wildly excited.

At almost the same instant, Ken also gave an exclamation. The thermometer dial for the gold sample had ceased to register.

"The blasted savage is stealing my sample!" he howled, and snapped over the switch closing the cargo door. The switch moved, but the door apparently didn't—at least, it failed to indicate "locked." There was no way of telling whether or not it had stopped at some partly-closed position.

The native was still jabbering—more than ever, if that were possible. Ken switched back to "open" position, waited a moment, and tried to close again. This time it worked.



The Sarrians wondered whether the relatively feeble motor which closed the portal had been able to cause any injury. There seemed little doubt about the cause of the first failure; if there had been any, the noise would have removed it.

"I don't think he was trying to steal," Feth said mildly. "After all, you repeated the name of the stuff more than once. He probably thought you were offering it to him."

"I suppose you may be right." Ken turned back to the microphone. "I'll try to make clear that it's market day, not a wedding feast." He gave a chirruping whistle, then "Tofacco! tofacco! Gold—tofacco!"

Feth shriveled, internally. If he could only learn to keep his big diaphragm frozen—

"Tofacco! Gold—tofacco! I wonder whether that will mean any-



thing to him?" Ken turned a little away from the microphone. "This may not be one of the creatures you've been trading with—after all, we're not in the usual place."

"That's not the principal question!"

Feth's tentacles coiled tightly around his torso, as though he were expecting a thunderbolt to strike somewhere in the neighborhood. The voice which had made the last statement was that of Laj Drai.

VII.

Roger Wing, at thirteen years of age, was far from stupid. He had very little doubt where his father and brother had been, and he found the fact of considerable interest. A few minutes' talk with Edie gave him a fairly accurate idea of how

long they had been gone; and within ten minutes of the time he and his mother returned from Clark Fork he had sharply modified his older ideas about the location of the "secret mine." Hitherto, his father had always been away several days on his visits to it.

"You know, Edie, that mine can't be more than eight or ten miles from here, at the outside." The two were feeding the horses, and Roger had made sure the younger children were occupied elsewhere. "I talked to Don for about two minutes, and I know darn well Dad was showing him the mine. I'm going to see it, too, before the summer's out. I'll take bets on it."

"Do you think you ought to? After all, if Dad wanted us to know, he'd tell us."

"I don't care. I have a right to know anything I can find out.

Besides, we can do a better job of scouting if we know the place we're supposed to be protecting."

"Well . . . maybe."

"Besides, you know Dad sometimes sets things up just so we'll find things out for ourselves. After it's all over he just says that's what we have brains for. Remember he never actually *said* we weren't to go looking for the mine—he just said he'd tell us when the time came. How about that?"

"Well . . . maybe. What are you going to do about it? If you try to follow Dad you'll be picked up like a dime in a schoolroom."

"That's what you think. Anyway, I'm not going to follow him. I'll lead him. I'll go out the first thing tomorrow morning and look for any traces they may have left. Then the next time they go, I'll be waiting for them at the farthest trace I could find, and go on from there. That'll work, for sure!"

"Who does the patrolling?"

"Oh, we both do, same as before. This won't take long. Anyway, like I said, since I'll be watching the trail they take, it'll be even better than the regular patrol. Don't you think?" Edie looked a little dubious as she latched the door of the feed bin.

"You'll probably get away with it, but I bet you'll have to talk fast," was her verdict as they headed for the house.

Twenty-four hours later Roger was wondering whether any excuses would be needed at all. Things had

not gone according to his sweepingly simple forecast.

In the first place, he had not had time to check any trail his father and Don might have left; for the two started out at daybreak the next morning. They did not follow the previous day's route, but the one Mr. Wing had always taken in years past—the admittedly zigzag path specifically designed to permit his scouts to take short cuts to warn him, in the event that anyone followed. Roger and Edith were given stations which were to be watched for one hour after the two men had passed; each was then to intercept the trail and make a report, whether or not anyone had been seen. Roger looked suspiciously at his sister for an instant when those orders were received, but decided she would never have told his plans. His father was simply one jump ahead, as usual.

A good fraction of the morning had passed by the time he had made his report, and watched his father and brother disappear to the north. This was not the direction they had gone the day before, according to Edith; now the question was whether or not they had bothered to lay a false trail on that occasion, too. The only way to settle that appeared to be a straightforward search for traces. That was not too hopeless; as Roger had said while telling his father about the new patrol arrangements, there were places practically impossible to cross without leaving some sort of track, and the mere act of avoiding all those places would

narrow down considerably the routes a person could take.

In spite of this, the boy had decided by dinner time that either he knew less about tracking than he had supposed or else the two he sought had spent the day in the attic. Certainly he had found nothing to which he could point with confidence as being evidence of their passage.

After the meal he had abandoned that line of research, and simply headed eastward. His sister had said they had taken this direction, and there was the remote chance that they might have abandoned precautions just that once. He traveled without pause for nearly half the afternoon, following what seemed to be natural trails, and finally stopped some eight miles from home.

He found himself in a valley, its center marked as usual by a noisy brook. The hills on either side were high, though by no means as high as some of their neighbors—six to seven thousand feet was a common height in this part of the range. He had not been here before, either alone or with his father, but still felt he had a good idea of his location. His principal worry was the fact that he had as yet seen no sign of his father or brother.

His intention was to work back toward the house from this point, zigzagging to cover as much territory as possible before dark. The first zig, he decided, should take him straight up the side of the hill to the south, thus crossing any pos-

sible trails cutting around this side of the mountain. After reaching the top, he could decide whether to go down the other side at once, or head west a short distance before sweeping back to the north. As it turned out, he never had to make that decision.

Roger Wing was not, of course, as competent a tracker as he liked to believe. As a matter of fact, he had crossed the trail he was so diligently seeking four times since leaving the house. His present location was at the foot of the hill bearing the open slope which the "miners" had crossed the day before, and within a mile of the Sarrian homing station. The course he now took uphill would have led him within a few rods of the transmitter.

However, he didn't get that far. Donald had been perfectly correct in concluding that no one could cross that slope of loose rock without leaving traces. Roger failed to recognize the marks left by the two on the way out, but he did find where his brother had forced his way through an unusually thick patch of brush at the top of the scree on the way back. It was carelessness on the older boy's part, of course; his attention at the time had been mainly taken up with the search for tracks left by the hypothetical followers, and had paid no attention to those he himself was leaving.

While the broken bushes gave Roger no clue to the traveler's iden-

tity, they indicated his direction very clearly; and the boy promptly turned westward. Had he stopped to think, it would have occurred to him that a trail in this direction hardly jibed with the assumption that his father and brother were going straight to the "mine"; but he was not thinking at the moment. He was tracking, as he would have told anyone who might have asked.

Once out of the patch of brush, the trail was neither more nor less obvious than it had been all along; but Roger was able to follow it. Probably the assurance that there was a trail to follow had something to do with that. He still did not know whether the traces had been left by his father, his brother, or both. He also failed to recognize the point where the two had come together after covering both sides of the scree. He simply went on, picking out the occasional scuff in the carpet of fir needles or snapped twigs where the bushes were thicker.

He descended the west side of the hill, after following it around from the point where the first traces had appeared. He crossed the narrow valley on this side, leaping the inevitable brook with little difficulty. Here he found the only assurance that he was actually following two people, in the indentations where they had landed on the bank after a similar leap. The marks were just dents, for the needles did not retain any definite shoe patterns, but there were four of them. They were in two pairs, one of each deeper than its

fellow, as though the jumper had taken the shock of landing principally on one foot.

Up the side of the next hill the boy went. It was darker now under the trees, for the sun was already concealed by the peak ahead of him; and presently he began to wonder whether he were really on the right trail. He stopped, looking about, and saw first to one side and then the other marks of the sort he had been following. He could not, he found, convince himself that those ahead of him were the right ones.

He tried to go on, then hesitated again. Then he began to backtrack—and reached the brook many yards from the spot at which he had jumped it. He spent some minutes searching for the marks, and when he had found them realized that he had not even followed his own back trail with any accuracy.

He should, of course, have headed for home right then. Equally of course, he did nothing of the sort. While the gloom on the mountain's eastward face grew ever deeper, he cast about for tracks. Every few minutes he found something, and spent long seconds over it before deciding to make sure—and then he always found something else. Gradually he worked his way up the mountain side, finally reaching open rock; and after deep thought, he moved around to the other side where it was lighter, and resumed his search. After all, the men had been heading westward.

He had crossed another valley—this time its central watercourse was dry, and there was no sign of anyone's jumping over—and was near the top of the unusually low hill on its farther side when he finally realized the time. He had been searching with a single-mindedness which had prevented even hunger from forcing itself on his attention. The sheer impossibility of seeing details on the shadowed ground was all that finally compelled him to consider other matters. He had no flashlight, as he had not contemplated remaining out this late. Worse, he had neither food, water, nor a blanket. The first two were serious omissions, or would be if his father heard of his venturing any distance into the woods without them.

It was quite suddenly borne in upon Roger Wing, as he saw the first stars glimmering in the deepening blue between the tree tops, that he was not another Daniel Boone or Kit Carson. He was a thirteen-year-old boy whose carelessness had got him into a situation that was certainly going to be uncomfortable and might even be serious.

Though rash, Roger was not stupid. His first action upon realizing the situation was not a wild break for home. Instead he sensibly stood where he was and proceeded to plan a course of action.

He was certainly going to be cold that night. There was no help for that, though a shelter of fir branches would make some difference. Also, there was no food, or at least none

that he would be able to find in the dark. Water, however, should be findable; and, after all, it was the greatest necessity. Remembering that the valley he had just crossed lacked a stream, the boy started on again over the low top in front of him and began to pick his way down the other side. He was forced to rely almost entirely on touch before he reached the bottom, for the lingering twilight made little impression on the gloom beneath the firs. He found a brook, as he had hoped, partly by sound and partly by almost falling over the bank.

He did have a knife, and with this he cut enough fir branches to make a bed near the stream, and to lean against a fallen log beside it as a crude roof—he knew that anything at all to break air circulation immediately over his body would be a help. He then drank, loosened his belt, and crawled under the rude shelter. All things considered, he was not too long in going to sleep.

He was a healthy youngster, and the night was not particularly cold. He slept soundly enough so that the crackling and crashing of branches in the forest roof failed to awaken him, and even the louder crunching as Ken's torpedo settled through the underbrush forty yards away only caused him to mutter sleepily and turn over.

But he was awakened at last, by the stimulus which sends any forest resident into furious activity. The cargo door of the torpedo faced the boy's shelter. The light from burn-

ing sodium and glowing gold and iron did not disturb him—perhaps they only gave him bad dreams, or perhaps he was facing the other way at the time. The blazing radiance of the burning magnesium, however, blasted directly onto his closed eyelids, and enough of it got through to ring an alarm. He was on his feet yelling "Fire," before he was fully awake.

He had seen the aftermath of more than one forest fire—there had been a seventy-five hundred acre blaze the summer before north of Bonner's Ferry, and a smaller but much closer one near Troy. He knew what such a catastrophe meant for life in its path, and for several seconds was completely panic-stricken. He even made a leap away from the direction of the radiance, and was brought to his senses by the shock of falling over the tree trunk beside which he had been sleeping.

Coming to his feet more slowly, he realized that the light was not the flickering, ruddy glow of wood flames, that there was none of the crackling roar he had heard described more than once, and that there was no smell of smoke. He had never seen magnesium burn, but the mere fact that this was not an ordinary forest fire allowed his curiosity to come once more into the foreground.

The light was sufficient to permit him to clear the little stream without difficulty, and in a matter of sec-

onds he had crashed through the underbrush to its source, calling as he went, "Hello! Who's that? What's that light?"

The booming grumble of Sallman Ken's answer startled him out of his wits. The drumlike speaking diaphragm on the Sarrian torso can be made to imitate most human speech sounds, but there is a distortion that is readily apparent to any human ear; and the attempt to imitate his words in those weird tones sent prickling chills down the boy's spine. The fact that he *could* recognize his own words in the booming utterance made it, if anything, rather worse.

He stopped two yards from the torpedo, wondering. The blue-white glare from the rectangular opening had died away abruptly as he approached, and had been replaced by a fading yellow-white glow as the crucible which had contained the magnesium slowly cooled. He could just see into the door. The chamber beyond seemed to occupy most of the interior of that end of the structure, as nearly as he could tell from his inadequate view of the outside, and its floor was covered with roughly cylindrical objects a trifle larger than his fist. One of these was the source of the white-hot glow, and at least two others still radiated a dull red. He had noticed only this much when Ken began to go through his precious-metals list.

Roger knew, of course, what platinum and iridium were, even when the first suffered from the peculiari-

ties of the Sarrian vocal apparatus; but like many other human beings, it was the mention of gold that really excited him. He repeated the word instantly.

"Gold!"

"Gold." The booming voice from the torpedo responded, and Roger found the courage to approach the still radiant doorway, and look in. As he had guessed, the little cylindrical crucibles were everywhere. The chamber was covered with white dust, the oxides of titanium and magnesium which had sprayed from the containers during the energetic reactions which had produced them. Tiny yellowish globules of sodium peroxide were spread almost as widely. A noticeable wave of heat could still be felt coming from the chamber along with a faint sulfurous smell, but when Roger laid a cautious hand in the dust of its floor the temperature proved to be bearable. He thought he saw what he supposed the hidden speaker to have been talking about—one of the crucibles seemed to reflect the yellow glint of the prized metal. The light was already too faint to be sure, however, and for a moment the boy stood undecided. Not for a great deal would he have stuck his head into that portal; it looked a little too much like a trap, and he couldn't see what controlled its opening and closing. After a moment's thought, however, he picked up a dead branch and used it to prop the little door open.

The light was even fainter now, however; and with some idea of making sure of what he saw, Roger unstrapped his wrist watch and brought its luminous dial close to the crucible he suspected. The improvement in illumination was negligible, but wishful thinking supplied what his eyes could not; satisfied as to its identity, he made a grab for the pot of gold.

He did not see the wires which connected its heater to the power sources of the torpedo. After touching the crucible, he did not even look for them, though they were the only reason he did not succeed in getting the container out. He had time for one good tug before the fact that the metal had only recently been melted made itself felt.

Roger, his face almost inside the compartment, yelled even more wholeheartedly than he had before, released the crucible, delivered a furious kick on the hull of the torpedo, and danced about, holding his scorched hand and hurling abuse at the unseen beings who had been responsible for the injury. He did not notice the stick which he had used as a prop suddenly snap as the door started to close, or the thud as the portal jammed against the fragments of wood. The sudden cutting off of nearly all the light, however, did catch his attention, and he saw what had happened when the door opened again. Without quite knowing why he did so, he swept the pieces out of the way with his uninjured hand, and a moment later he

was left in darkness as the door closed completely. He had an uneasy idea that he was being watched.

Again the voice boomed out. He recognized the word "gold" again, but the syllables which alternated with it were too much distorted for him to understand. He had, after all, no tobacco on his person, and there certainly was none in the torpedo, so that there was nothing to bring the substance to mind. He made no attempt to imitate the alien-sounding word, and after a moment the utterance ceased.

It was replaced by fainter sounds, which somehow did not seem to be directed at him, although they had the complexity of speech. Roger would not, of course, have analyzed them in just that way, but he got the distinct impression that they represented a conversation he could not understand.

This lasted for what seemed to the boy a long time; then the earlier refrain broke out again. "Gold—to-facco—gold—tofacco!" Eventually it got on even Roger's nerves, and he yelled at the dark hulk.

"I don't know what you're saying, darn you! I won't touch your gold again, and I don't know what the other words are. Shut up!" He kicked the hull again, to emphasize his feelings, and was rather startled when the voice fell silent. He backed away a little farther, wondering what this presaged. It was well he did.

An instant later, without preliminary sound, the dark shape of the

torpedo lunged upward, crashed through the overhanging branches, and vanished into the black sky with a whistle of protesting air. For minutes the boy stood where he was, gazing up through the gap smashed in the limbs; but nothing rewarded his efforts except the stars.

Roger Wing got very little sleep that night; and the fact that he got his feet wet finding his shelter was only partly responsible.

VIII.

"No, that's not the principal question." Laj Drai repeated the statement rather thoughtfully, as he glided into the shop and absently closed the door behind him.

"Sir, I—" Feth got no farther with his expostulation.

"Oh, don't let me interrupt. Go right ahead, Ken—you have a problem on your hands, I see. Get it out of the way, and we'll tackle the other afterwards. There'll be no interruptions then."

Rather puzzled, for he had completely forgotten Drai's threat, Ken turned back to his microphone and resumed the apparently endless chant. While he did not understand the words with which Roger finally interrupted, the thing had gone on long enough so that he shared the boy's impatience to some extent. Also, the clank as Roger kicked the torpedo was at least suggestive.

It was Drai who drove the projectile into the air, an instant later. He
(Continued on Page 151)

THINKING MACHINE

BY H. B. FYFE

There are various sorts of analogue computers. The one they had in the Lab was good — but the kind the stranger had in mind was better. And much, much deadlier —

Illustrated by Cartier

Engineer Oscar Kleweski watched the technicians preparing to blast the world beyond recognition. The shining globe in the pit spun serenely on its axis, causing the white shroud of clouds to split into bands with differing rotational speeds.

"Look, you guys," repeated Lane from beside his camera battery, "are you sure you quoted me the maximum speed?"

"Don't worry," answered Schultz. "There won't be any pieces shooting back at you. Kleweski wouldn't let us."

"You want it all on film, don't you?"

"It'll be all right," said Kleweski, and turned to the tech handling the satellite. "Orbit double-checked?"

Plump Turino lifted dark eyes briefly, curled an assenting lip, and re-examined the controls of his force beams.

"Then let's tear it down!"

Kleweski retired with his clipboard to a platform at the rear of the observation balcony. The technicians were ranged along a row of control panels before him. Over their heads, he had a good view of the twenty-foot sphere hanging in the center of the experimental pit, which was three hundred feet across and the heart of the orbital space station built around it. The balcony was shielded from the central vacuum by a field of force easier, like gravity, to manipulate out here in space.

Turino laid aside a half-eaten

chocolate bar and hunched over his instrument panel. From the right, lit like the planet by artificial sun lamps, glided a four-foot globe. It fell into an orbit about the larger one, circled it three times for Lane's recording lenses, then edged gradually closer.

"Another one shot," predicted Schultz. "Took me three days to build up the pseudocontinents on that model."

"It may not need complete dismantling," said Kleweski.

"Hope they don't take apart the core of the big one," Schultz muttered gloomily. "Working those iron wedges back into place is a job."

"So is calculating their velocities from the film."

"There's the 2.58 the real moon has," announced Turino.

The smaller globe had moved delicately inward and speeded up in its orbit. Tides in its seas and in the cloudy atmosphere of the planet were now marked. At regular intervals, Turino called off the distance in terms of planet radius. Kleweski took down data without shifting his eyes from the scene.

"Due pretty soon, ain't she?" asked Schultz, as the moon circled within the 2.44 radii of Roche's limit. "Oh-oh! Here comes The John!"

Kleweski glanced over his shoulder. Through the extra door at the end of the balcony came Charley Johnson, the office politician of the engineering department.

"What's that with him?" gasped Schultz.

"Something from around Arc-turus," answered Kleweski. "He came to make Doc Lawton an offer for the lab."

"No kiddin'?" Schultz thought that over. "You have a piece of it like the other engineers. You gonna sell?"

"Got my doubts. Let's get on with this, and talk later."

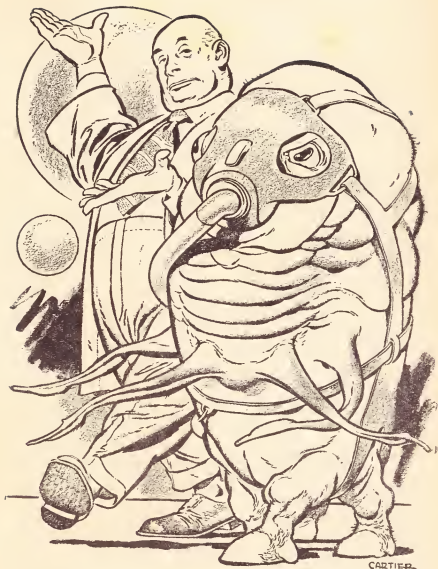
Johnson nodded to Kleweski, and led his squat, squarely built guest to a position of vantage at the end of the balcony. The Arcturan was a head shorter than Kleweski's six feet, but better than a yard wide. He looked as if put together to stand anything. Four stumpy legs supported a body sheathed in rubbery, walnut-brown skin and sporting four less muscular tentacles about waist-high—if the Arcturan had had a waist. Most of the features on the broad head, save for two wide-set eyes, were concealed by a breathing mask. Kleweski thought he saw a vocal filter slung from the stranger's harness, indicating that the Arcturan's range of speaking sounds was unearthly.

"Showing signs," warned Turino.

"A liquid satellite would be gone before now," Kleweski told Schultz. He called, "Let's squeeze out the last millimeter!"

"Out of my hands," Turino reported after another moment.

The satellite had achieved an improbable proximity to the larger sphere. Lane's cameras recorded the surface disturbances. A chorus of



exclamations arose as the moon began to break up. Most of the pieces curved "down" to the major globe. The white clouds became roiled by tiny flames, and shot out wisps of vapor as larger bits struck the surface.

In the end, three small, irregular moons circled the ruined planet. The clouds had been dispersed or condensed, revealing Schultz's surface details to be a complete mess.

"And no rings, even!" he complained. "Oughta be rings."

"Look closer," said Kleweski. "I think there's an irregular one forming now. If we keep the setup long enough, it'll smooth out. It's just hard to see because most of the stuff fell to the surface this time."

"Some mess," remarked Charley Johnson. "The Altair job?"

Kleweski nodded, gathering his papers from a data desk.

"Altair VII, after a planetoid displaced their satellite. When we analyze the film, we can tell them the symptoms of critical approach—atmosphere tides ought to be easiest to spot. I don't think they'll have to move yet; but it won't hurt them to start hunting a place to colonize."

"Well, if you're finished, the showdown's going to get underway in Lawton's office."

"I'll be there," said Kleweski.

He watched the crew begin to let air into the pit as Johnson left the chamber with the Arcturan.

"Showdown, huh?" commented Schultz. "You guys don't all want to sell, I guess. But Lawton does?"

"Not much we can do," admitted Kleweski. "He practically built this place from the pit out, and he owns most of it."

"What's he wanna sell for?"

"He wants to build a bigger station. With two or three pits and extra observatories to lease to astronomers."

He tapped his clipboard moodily against his thigh, and stared at the "planet" Turino was maneuvering with his force beams to the side of the pit.

"It'll cost plenty," the engineer added.

"Bet he's been making plenty," said Schultz. "Done everythin' from proving ring formation or predictin' planet formation for other stars to estimating positions of lost spaceships."

"True, but he still needs a big chunk of cash. Only—I'm not sure I want to turn my part of this lab over to some promoter from space without knowing it'll be used for the public good."

Leaving Schultz to supervise the salvage of materials, he dropped his notes at the cubby called his office and took an elevator to the conference room. Most of the others were already present, waiting for Dr. Lawton, Johnson, and the Arcturan. Kleweski slumped lankily into a chair and stared at a schematic diagram of the station framed on the bulkhead.

Seen from top or bottom, the station resembled a sphere. In effect, it

was one, although an equatorial view revealed it to be actually a squat cylinder, with bulging observatory domes above and below. The experimental pit was at the center, shielded, and surrounded by levels of compartments for living, working, and housing the mechanisms used to manipulate the material in the pit. Besides these levels, which were laid out in octagonal bands about the pit with safety doors at the angles, supply levels extended to the skin of the station. Most of these, except for the air-conditioning chambers and elevator shafts, were kept airless. They included two sally-ports, each housing a pair of light rockets, which were reached through air locks from the working levels.

Then the door at the end of the room opened and Dr. Lawton ushered in the prospective purchaser.

"... And so that's the way it went," Kleweski told Schultz some hours later. "His name is Ouayo, from Arcturus V, and he has enough in one of Terra's main banks to swing the deal."

"But you didn't go along?"

They were sitting on a table in Schultz's workshop, amid scattered heaps and boxes of materials the technician used to simulate the outer crusts of planet models.

"No," said Kleweski, "I said I'd rather keep an active interest, since there would be no chance for similar research until Lawton gets the new station built."

"So?"

"So Lawton finally smoothed

things over and got Ouayo to include me in the contract. They decided my services would be vital, anyway, because I know the place inside out and the Arcturan will need somebody to drop down to Luna for supplies and gadgets from time to time."

"That's right," agreed Schultz. "Running the station is no one-man job, for all it's loaded with automatic gadgets. Well, guess I might as well start packing my stuff, huh?"

"Take your time," said Kleweski. "You have a whole week."

Schutz's eyebrows rose at that. He uttered a low whistle.

"What's his hurry?"

"I don't know; he's a close-mouthed lump. But he must have something queer on the fire. Schultz—"

"Yeah?" encouraged the other as the silence lengthened.

Kleweski, who had been staring into emptiness as if at some unpleasant vision, shook himself slightly.

"I was going to say that I'd like to hear from you once in a while, when you have time to send a light-gram."

"Sure."

"I mean . . . well—"

"Sure," repeated Schultz, looking at him keenly. "I'll expect you to answer them, too."

"That's right," said Kleweski.

The task of moving the personnel from the station took most of the week, but went smoothly enough ex-

cept for a rush job on models Ouayo insisted on having built.

Kleweski, detailed by Lawton for a trip to Luna to arrange storage for laboratory records of completed and projected experiments, missed most of the furor.

Upon his return at the end of the week, the first person he encountered after reporting to Lawton was photographer Lane.

"Say, you ought to see the pit now!" Lane greeted him.

"What's the matter?" asked Kleweski.

"They've been driving the shop men night an' day to fill it up with models. How many you think they crammed in there?"

"How many?" demanded Kleweski.

"Sixteen!"

"Huh?"

"That's right! Four planet-size with three moons apiece."

"They're crazy!" exclaimed Kleweski. "They'll have them rattling around like dice!"

"It was runnin' pretty good when I saw it. Look up Schultz; I think maybe he has a key to the balcony."

"Why? Have they got it locked?"

"Orders from the Arcturan Lump," Lane nodded. "He must be inventing something secret. Did you see that stuff in an orbit around the station when you came in?"

"Six or eight big drums? They his?"

"Yep," said Lane. "Won't load them into the station till we're gone. I'd almost like to stay to find out

what they are, but that Ouayo gives me the creeps."

Kleweski left him thoughtfully and sought out Schultz. He found him snoring on a bench in his workshop.

"Oh, you're back?" mumbled the technician, sitting up and rubbing his eyes. "What's new?"

"I hear tell there's something new in the pit."

"Oh, that . . . yeah. What a job to do in a week! We worked three shifts on those models. Everything had to be just so, even to using a special solution for the oceans. Ouayo brought that in from his baggage outside."

"Lane says they have the place locked."

"Yeah, but I haven't sealed all the emergency hatches yet. Want to take a look?"

Kleweski nodded. Schultz, yawning, led him out of the model shop into the corridor, past two angles in the octagonal floor plan, and down to the machinery level.

This belt of mechanisms used to operate the pit and to generate power for the rest of the station was about thirty feet high. A similar level was immediately below, but deck to deck, with the artificial gravity opposite in direction.

"Here's the hatch across from the control balcony," said Schultz. "That is, it's down this ladder."

He dropped headfirst down the ladderway, like a good swimmer nonchalantly diving from a low float. Halfway through the thickened deck,

he grabbed a rung of the ladder and began to climb "down" as he passed the plane of the space station's equator. Kleweski followed, and found Schultz swinging open a small, thick hatch.

Having removed this like a cork from the neck of a bottle, Schultz led the way through a short tunnel in the pit shielding. He opened a similar cylindrical portal at the other end, and they gazed out into the pit from a niche that was recessed to be outside the field of force that maintained the pit vacuum.

Kleweski exclaimed.

"What a scramble! How did you get them all in?"

Four twenty-foot spheres hung in the artificially lighted void. Around each revolved two smaller ones, proportioned as rather large moons. Several others glided toward each other near the center of the pit.

Kleweski thrust his head forward, studying the glowing models in their orbits. After a moment of silent analysis, the pattern suddenly burst upon him.

The four "planets" were spaced equally around the pit, midway between center and the outer limits. Two moons of each followed orbits in the same general plane. The third satellite in each case moved in an elongated ellipse perpendicular to this plane, each cutting down between its two mates at one end of the journey and at the opposite extreme coming almost to a junction with

the other odd moons at the center of the pit.

"What's he trying to do?" grunted Kleweski. "There never was such a system. At least, the odds against it are fantastic!"

"Designing one of his own," suggested Schultz sarcastically. "Easy to get around in as a subway. Each planet has two locals, plus one express to all points past the center."

Kleweski did not laugh. His eyes widened.

"Maybe you're not kidding," he muttered. "It's made to order from a viewpoint of economizing on spaceship fuel."

He eyed the setup for a few minutes, then thanked Schultz and thoughtfully made his way to his own compartment.

He had still not made up his mind a few days later as he stood shivering in the poorly heated observation dome atop the station's north pole. He had just turned away from peering through a small telescope at the last receding rocket trail of the ships carrying away members of the laboratory staff.

Which is now reduced to two, he reflected. Ouayo and me!

He left the dome by the little car that ran through a bulging "great circle" tube on the station's exterior, and dropped down to the working level and a narrow passage through the supply compartments.

"I suppose Ouayo's busy getting in his secret equipment," he muttered. "Stuff like those language records he gave me."

He wondered why the Arcturan had not yet changed the air of the station to whatever he breathed. Still, he told himself, it was none of his business and Ouayo's preoccupation with other matters was saving Kleweski the trouble of wearing a breathing mask. He decided to have a look into the pit before making another inspection round of the space station.

He found the entrance to the balcony, and looked in upon a mystifying sight. Ouayo stood blockily before a small television screen, the center of a strange new assembly on one of the data desks. Kleweski's first feeling was chagrin at having been left out of whatever experiment was underway. Then he noticed one of the mysterious tanks Ouayo had been keeping in an orbit about the station.

The Arcturan was speaking. To whom, Kleweski could not imagine, but it gave him a moment to examine the tank.

The end, of which he had an oblique view, was open. Out of it, tiny sparks were being projected toward the nearest-model planet. The engineer stared.

After a few minutes of feeling like a spy, he coughed deliberately. Ouayo looked around. Catching sight of Kleweski at the top of the short flight of steps, he beckoned with one arm and returned his attention to the screen.

Kleweski joined him, feeling unwanted. Then he saw what was on the screen.

The scene was obviously the control room of a spaceship. A being more weird in appearance than even Ouayo was speaking to the latter. He completed an announcement or report and was replaced by a view of a group of vessels in space. The speaker came back on, said something to which Ouayo made a brief reply, and again the view changed.

It showed the surface of Terra, from about four or five thousand miles. There were islands, many of them—

Kleweski's jaw dropped.

"No, it's not Terra!" he murmured.

It definitely was not his home planet but something else. However he sought to disbelieve his eyes, the views matched perfectly—one an image in the screen, the other a model in the pit before him with island patterns arranged by Schultz's loving care.

He turned to examine the open-ended tank more closely. Those little sparks—*they were rocket trails!*

Ouayo spoke again. He made a note of the answer, gave instructions too fast for Kleweski's artificial memory of the language, and waddled away from the screen.

"I did not expect you," he said, choosing to speak Kleweski's language despite the sessions the engineer had put in to learn Arcturan by means of hypno-records.

Kleweski wondered if the Arcturan were angry, or amused, or

contemplating the extinction of a prying Terran.

"Perhaps I can explain," said Ouayo slowly. "Like me, you have inquiring mind . . . no? Is silent knowledge more attractive than . . . to . . . make oneself large with . . . with half a story?"

"I'm curious, yes," admitted Kleweski. "You mean you'll explain if I promise not to repeat it?"

"Slower, please!" requested Ouayo.

Kleweski said it again.

"Yes," answered the other with simple directness.

Kleweski tried to match him with a quiet, "Go ahead!"

"Then," said Ouayo, "these are my . . . clients."

Kleweski looked speculatively at the tiny flame trails.

"How did they get so small?" he asked.

"The Maker of All may answer you that," the Arcturan told him dryly. "They were miniature planetary system in my volume of space. Their sun size your Luna, but dying."

"How did you find them?" asked Kleweski.

"Who shall determine at first hear the magnification or distance of a signal? I, also, astonished when reached their system in the body. However — was plain something needed."

"So they became your . . . clients?"

"Exactly, and more. Engaged me to discover suitable new habitation.

They will repay with . . . scientific information . . . formulas, designs, inventions for many purposes. Also they undertake at my . . . request . . . to occupy ten per cent population with my research calculations."

Kleweski stared at him in awe. *Just like an electronic brain*, he thought.

The Arcturan had, to all intents, acquired a super-computer, a thinking machine that could direct itself by its own intelligence and build mechanical sub-computers to carry on fantastic amounts of detail work.

"In spite of price I paid Dr. Lawton," said Ouayo, "I expect make a shameful profit . . . that is . . . is 'shameful' right?"

Kleweski was about to say it was all in how you looked at it, but it occurred to him that there might be another view.

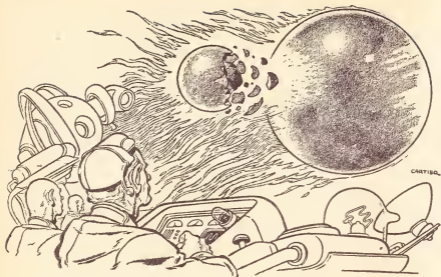
"What about these . . . people?" he asked. "Are they quite willing?"

Ouayo made a little gesture with his tentacle tips.

"Are they to choose?" he asked blandly. "They are in position to be willing. Should they not—!"

He flipped a tentacle at the assembly of model planets in a gesture that left little doubt as to his intentions.

Kleweski eyed the spinning models. There would already be a sort of life on them; he now suspected the nature of the special sprays Schultz had been given to use. There would be what a Terran might mistake for molds or bacteria or some yet un-



known form of microscopic life. The tiny beings doubtless had animals aboard their ships. Worlds made to order!

And all under the ruthless control of Ouayo, a mere machine to be worked for his purposes!

How did I ever get myself into this? he asked himself.

Bewildered at the revelation, he presently excused himself on a plea of needing sleep, and retired to his own quarters.

There, he stretched out on his bunk and tried to view the situation dispassionately.

"It's beautiful, in a way," he murmured. "A limited population, to fit into the ships and on the models, but enough to do Ouayo's calculations. Why, it's as if you had everybody on

Terra supporting a huge effort aimed at doing one scientist's incidental arithmetic! Or sorting out possible answers to any question. Organic cybernetics, you might say—a setup that can not only solve problems at a staggering rate but also use judgment and initiative doing it!"

Yet he knew that was only part of the situation. What of the inhabitants of the artificial system in the pit? Was there any name for them but 'slaves'?"

"Of course," he reflected, "it's only fair that Ouayo be repaid for what he's done for them; and the only likely medium of exchange is *knowledge*. That isn't curtailed by differences in size or location."

Behind this rationalizing, how-

ever, was the memory of Ouayo's gesture at the mere suggestion of disobedience.

Kleweski began to squirm out of his clothes for bed.

"Not my problem," he decided. "They made the bargain with Ouayo. I don't enter into it at all. I'm just a sort of janitor here now. As long as I keep the station air-tight, warm, and lighted, it's none of my business."

Having lowered his thermostat, he blew up the inflatable pillow issued in the station, pulled up the covers, and turned out the lights. The next thing he did was spend several hours wondering why he could not get to sleep.

In the end, he sat bolt upright with a curse.

"I wonder if he's still in the pit chamber?" he muttered.

He pulled on pants, shirt, and moccasins, and padded softly down the corridor. When he reached the main door to the pit balcony, on the next level, he hesitated. Somehow, he could think of no good excuse for intruding. Shrugging, he opened the door to peek in.

The control balcony was deserted and dark, save for a few discreetly gleaming lights on the instrument panels.

Kleweski entered quickly, not pausing to admire the rotating spheres in the pit, which looked the more brilliant for the dark foreground. He glanced about to make sure Ouayo had not retired to a

seat to rest. He was alone.

He walked slowly down the few steps to the controls. The Arcturan's telescreen was dark, but indicated by its dials to be in operation. To it was connected an attachment reminding Kleweski vaguely of a relay device.

"I see," he mused, considering the arrangement. "He has another receiver in his quarters in case of a call. Could I disconnect him a few minutes, I wonder?"

Working gingerly lest he give an alarm, he succeeded in doing so. As an extra precaution, he padded back up the steps to lock both doors before attempting to use the set.

Satisfied that he would not be burst in upon without warning, he considered the mechanism. His knowledge of written Arcturan was nonexistent, but there seemed to be an automatic calling key. He depressed it and waited.

In a moment, the screen glowed, and a burly little monster came slowly into focus.

Where his flesh showed between parts of his simple clothing, it was covered by salmon-pink, iridescent scales varying in size. Kleweski noted a fishy mouth and four multi-jointed arms, but no noticeable shoulders or neck. As if to offset the inflexible position of the head, there were four mobile, wide-spaced eyes. These immediately focused upon Kleweski.

Somehow, the effect was so very like an expression of astonishment that Kleweski nearly laughed. He

controlled himself to speak in the simple Arcturan he had learned from Ouayo's records.

"Who are you?"

The four glittering black eyes flickered to Kleweski's lips as he spoke. The creature then pivoted to beckon an unseen companion, revealing dorsal scales thickened into armor.

"Are you of Ouayo?" came the counter question when the first individual had been joined at the screen by two others.

"Not exactly," said Kleweski, unable to discover a memorized expression to define the relationship precisely. "I am from a near planet. I am hired to work for Ouayo."

The three examined him with an intensity that suggested anger or dislike. The speaker inquired what was wanted "now," using a term for Ouayo that was unknown to Kleweski. Some linguistic instinct told him it was synonymous with "master."

"Nothing," he said. "I was curious. Who are you?"

"We are the *Skrenthi*. We are those rescued by—"

Again, Kleweski failed to understand the title.

"You mean Ouayo, the Arcturan?" he asked.

"Ouayo, yes."

"He tells me," said Kleweski, "that you have agreed to help him in his researches."

"What did he tell you?"

Kleweski repeated Ouayo's story. The *Skrenthi* eyed him.

"He is kind to put it that way," said their spokesman.

The statement seemed subtly "wrong" to Kleweski, like an out-of-place note in a half-remembered tune. He analyzed it in view of his limited artificial knowledge of the language.

Oh, I see! he thought sheepishly. *He's being sarcastic.*

"Are you not willing?" he asked bluntly.

The eyes stared at him again.

"What will you tell him?" he was asked.

Kleweski reiterated his denial of any close connection with Ouayo except for employment. Requested to describe the surroundings, he labored to deliver a word-picture of the space station and Terra, about which it circled. The *Skrenthi* exchanged significant looks, then offered him some pithy advice.

"Return to your world, you of Terra, before you, too, are in the power of Ouayo!"

Kleweski was startled.

"What do you mean?" he demanded.

"If you do not know his treacherous greed, take warning! If you do know, you will deserve whatever results from continuing your association with him."

I don't blame them, thought Kleweski. *He has them in the bag and there's nothing they can do.*

He opened his mouth to reply, but hesitated. Was that a sound in the corridor?

With silent haste, he flicked out a hand for the connection he had loosened. He replaced it, then bounded up the short flight of stairs to unlock the main door at the head of them.

He pressed an ear against the panel. Yes, there was the padding sound of the Arcturan's short strides approaching.

Kleweski slipped along the curving balcony toward the far door. The *Skrenthi*, he saw from the corner of his eye, had taken the hint and were fading from the screen.

If I get out before he gets all the way in, he thought, it's only a few steps to an angle in the corridor.

He made sure the end door was unlocked, and waited by it until he saw the handle of the other entrance begin to move. He stepped into the passage, easing the door shut behind him.

Kleweski started back to his quarters by another route through the office level, but stopped halfway there as a thought struck him. Ouayo would probably be occupied for some time. The engineer decided it might be prudent to listen in on any conversation between the Arcturan and his "clients."

He did not enter Ouayo's cabin when he reached it, however, for he discovered that the other had begun converting it to suit his natural habits of life.

"Air-tight!" muttered Kleweski, scanning the gauges beside the entrance. "I'd better not go in there without a spacesuit."

He walked slowly to his own compartment, wondering how foolish it would be to confront Ouayo with the story he had just heard and demand an explanation.

And what if there is none? he asked himself. Do I quit—give up a good job for a chuckle-headed conscience?

Just as he reached his door, beside a turn in the passage, he thought he heard a noise. He looked over his shoulder—and ducked frantically aside! Ouayo had rounded a far angle of the corridor and was aiming some sort of weapon at him.

"Hey!" yelled Kleweski. "What's the—?"

His voice was drowned out by a report that reverberated along the passage like a roll of thunder. A bolt of flaring energy seared a man-sized blotch on the bulkhead beside Kleweski's door. Even where he landed, around the angle in the corridor, he felt the heat.

No use arguing with him now, decided the engineer, sprinting away. That's a hot jet he carries, whatever it is!

He wondered what to say if Ouayo called after him, but the Arcturan wasted no time in such overtures. Kleweski heard the clumping of four thick feet in pursuit.

Either he knows I spoke to them, he thought, or else he'd already decided to get rid of me as soon as I saw the Skrenthi.

He skidded to a halt beside an elevator shaft. The dial showed the

car one level below. He jabbed the button.

Before Ouayo rounded the corner, the door slid open. Kleweski was inside in a flash, pushing a floor button at random. As the car descended, he tried to catch his breath.

He slipped out at the first machinery level. Immediately, the car started upward in response to Ouayo's persistent signal.

"I'll be better off in the other hemisphere," muttered Kleweski, making for a hatch. "Then I want a word with *them*."

Twenty minutes later, after a brisk run through some of the lesser used byways of the station, he climbed up a ladder near the observation balcony. To his cautious stare from deck level, the passage looked clear.

"Still out looking for me," he murmured, climbing out.

As silently as possible, he crept to the balcony door. Far from being locked according to Ouayo's habit, it was ajar. He peered in, prepared to duck at the slightest sound, but the place was unoccupied. Kleweski locked the door behind him and checked the other exit. Then he went to the telescreen.

The three *Skrenthi* appeared as soon as he pressed the key.

"We have waited for you," said their spokesman.

"Sure it was *me* you were waiting for?" asked Kleweski.

"Yes, we are sure. The Other One departed in a vengeful manner,

aware, we think, that you communicated with us."

"Yes, I saw him," replied Kleweski.

"What did he say to you?"

"*Bang*—more or less. What I want to know is what you said to him!"

The *Skrenthi* glanced at each other with their mobile eyes.

"It was necessary that we admit hearing a call," said their spokesman. "We are not quite able to resist him."

"That's fine!" growled Kleweski, wondering in passing if the Arcturan translation would still be sarcastic. "I was hoping *you* could tell me how to handle him."

The *Skrenthi* considered that.

"We might possibly offer advice," Kleweski was told, "unless Ouayo can hear."

Automatically, Kleweski looked to see if the Arcturan had left the relay device connected. He had; but he had also left something on top of it—a small, ruggedly built radio. Kleweski held it up by the carrying strap for the *Skrenthi* to see.

"Is this what he uses?" he asked.

"That is our design, yes. He has a relay mechanism connected to the communicator you see, with an auxiliary unit hooked up somewhere beyond the limits of this new cosmos—"

"*Ssssh!*" Kleweski interrupted.

He was sure he heard a noise outside the door. He picked up the little radio and tiptoed up the steps.

Even through the metal, the report of Ouayo's weapon was star-

tlingly loud. A spot around the handle of the door glowed red before Kleweski's eyes. The door sagged an inch.

No time to get out the other way! thought Kleweski.

A frantic leap carried him to the control panels. He flipped a switch at one of them with taut fingers, and twisted a dial slightly. When he reached over beyond the railing, the insulating field had retreated about a yard.

Kleweski vaulted over the rail, as the door clanged open.

He's through! he thought. *Now if only he doesn't look at the pit until I reach that hatch across the way—*

After dropping several feet on the momentum of his jump, the engineer felt himself sliding to a stop against the curving metal. Artificial gravity forces were practically nonexistent where he was. He began to squirm and claw at the surface.

If he looks over the edge, he reflected, all he has to do is shift the force field back to normal. He could flatten me thin enough to make rings for one of the planets!

Changing his tactics, he set his back against the field and pushed at the bulkhead with hands and feet, bracing like a mountain climber making his way by friction. He was congratulating himself on making good time when he heard voices relayed on his radio. He paused to listen.

Though the speech was too rapid for him, he gathered that the *Skrenthi* were denying having seen

the Terran.

Kleweski grinned and kept going. After an effort that left him panting and damp with sweat, he located the niche from which Schultz had shown him the pit arrangement. He pulled himself into it, feeling weight again as he moved outside the potential limits of the pit.

"Terran!"

He started at the sound, then realized that the *Skrenthi* were calling through the relay. He hitched the radio around, squinting past the nightmarish, glowing spheres at the balcony.

"Has he gone?" he asked.

"Yes. Have you escaped? He is searching, we think."

"I found a better hole," said Kleweski. "Now, what were you about to tell me?"

"You requested advice. We have long spent much effort on analyzing Ouayo for faults and weaknesses. What weapon have you?"

"That's a good one!" muttered Kleweski mirthlessly.

"We did not hear you."

"My two hands," said the engineer more plainly.

It created a pause. Then the *Skrenthi* checked back.

"You are being ironic?"

"Exactly," said Kleweski.

"We . . . understand. Ouayo has been . . . difficult for us also. Perhaps our estimate of his mentality would interest you."

"Perhaps," said Kleweski.

"We think it will be quite hard to fool him. However, any intelligent

entity has some limit to the number of actions he can consider or carry on simultaneously. After long study, we conclude that Ouayo would probably be confused by more than four simultaneous alternatives."

"If I had five or six places to shoot him from, and he saw them all at once, he might forget to duck?"

"That is one example," agreed the *Skrenthi*.

If I had something to shoot him with, thought Kleweski.

"We advise you to set a trap for him."

"Thanks a lot," retorted Kleweski.

I'd better get out of here, he told himself.

Cautiously, he pushed open the hatch and traversed the short tunnel. Emerging from the other end, he started for a ladder to the upper levels but changed his mind.

"Come to think of it," he muttered, "aren't the main gravity controls in one of these machine compartments?"

He walked along watchfully, and presently spotted the control room in question. It took him only a moment to step inside and cut the artificial gravity by half.

Now I can make some time, he congratulated himself, *bounding along at a previously impossible speed. Wonder what Ouayo thinks of that? Maybe I ought to do as they said. Some place like the hangar air lock might do.*

He saw no sign of Ouayo as he sneaked "down" through the thick

central deck and then "up" a ladder to the section near the air lock.

After a few moments of thought, during which he was annoyed to catch himself peering frequently up and down the corridor, Kleweski went to work. He chose a spot where two supply compartments opened on the corridor near the air lock.

For safety, this section was bounded by an extra air-tight emergency door besides the one at the nearby angle in the passage, making a twenty-foot supplemental air lock. Next to one of the compartment exits was a ladder up the bulkhead to a high hatch. Kleweski climbed up, swung open the hatch, and stepped into the air lock beyond which the rocket was berthed.

He moved certain controls. Sections of bulkhead opposite him began to slide open. Air rushed out, and the hatch started immediately to close. Kleweski hastily dropped through and let it snap shut above his head. As it did so, the two big emergency doors ceased their closing motion and slid back into the bulkheads.

Kleweski nodded in satisfaction.

Now to fix it so he'll stick that ugly head of his into the airless chamber, he thought.

He opened the door beside the ladder and bolted the one on the opposite side of the corridor. There was no purpose in having it bolted, and he hoped that Ouayo might wonder momentarily why it was. He decided that a loud noise of some kind should help, and rummaged around



a workshop down the line till he had hooked up an electric bell. This he planted some way beyond the standard safety door but led a loop of wire with the switch back around the angle. Several pipe lines ran overhead, and Kleweski tied the wire to one of these.

He picked up the radio he still carried with him, to ask the *Skrenthi* their opinion of his setup. When his call went unanswered, however, he remembered the shielding around the pit. Ouayo's relay auxiliary would be on the other side of it.

There's just one more thing, he decided. If he doesn't get sucked into the air lock and pop a few blood vessels in the vacuum, I'll need a way out of here fast! Maybe I'd better shut off that safety door.

He found the switch in the bulk-

head at the corridor angle, and immobilized the door.

"Now," murmured Kleweski, "all I need is to find a good, big monkey wrench and go looking for Ouayo!"

As it turned out, he never had time to choose a weapon. Returning to the shop to search for one, he heard the hum of a nearby elevator. About thirty feet away, the door slid open. Kleweski ducked into the shop.

Too late! he thought. *He saw me!*

He heard a rapidly approaching *pad-pad-pad* and ran for a connecting door to the next compartment. It was a half-empty storeroom. He scrambled over light plastic bags of various colors toward the corridor exit. Something in the shop hit the deck with a jingling crash. Small objects, sounding like nails or bolts,

continued to bounce lingeringly in the light gravity. .

"Stop where you are!" called Ouayo.

Kleweski tore open the door and set sail for the angle in the corridor. Behind him, he heard a commotion as the Arcturan drove after him through the storeroom.

Panting, he bounced to a halt at the intersection he had prepared for the showdown. He leaped for the handle of the hatch to the air lock without bothering with the ladder.

The sound of Ouayo's approach became louder, then was drowned out by the gush of air escaping into the lock and through it to the rocket cradles and space. Kleweski opened the hatch as far as he could and dropped back to the deck.

The supply compartment doors faced each other, one ajar and one bolted. Electric motors hummed as the extra emergency door and the overhead hatch began to close in response to the decreasing air pressure. The gush of air was approaching a moan.

The Terran, with the strap of the radio clamped between his teeth, had just pulled himself up among the pipe lines along the upper pit-side corner of the corridor when Ouayo bounded through the inoperative doorway. Kleweski pressed his button, sending the bell back down the passage into strident life.

The Arcturan spread his four stumpy legs as brakes. One tentacle grabbed at the ladder. The bulky blaster came up viciously to cover

the moving safety door ahead.

Ouayo dismissed that immediately. He side-stepped, slapped the left-hand door wide open. He drove a blast of heat across at the other door. Kleweski saw the bolt area flare white. The thunderclap deafened him. Ouayo leaped for the overhead hatch. Spatters of hot metal from the blasted bolt pattered on the deck. Ouayo shoved the half-closed hatch back, bracing one tentacle on the ladder. Then he recoiled to drop back to the deck.

I lose! despaired Kleweski. *He didn't make the mistake.*

Something deep inside him flinched in sheer terror as he released his grip and kicked off from the bulkhead to gain power for whipping the radio straight at Ouayo's broad head and the eye that had just discovered him. The Arcturan, twisting awkwardly in midair, swung his weapon around.

In the reduced gravity, the radio snapped across the corridor like a cannon shot. Just before Ouayo's thick feet slapped on the deck, while Kleweski was still falling, it struck.

Ouayo spun off-balance and thumped against the bulkhead, catching between it and his own bulky body the blast already triggered for Kleweski.

The report was soggily muffled.

Kleweski found himself on hands and knees, staring wide-eyed at the queerly collapsed brown hulk that had been knocked away from the bulkhead to sprawl across the deck.

A two-foot length of tentacle with

a seared end marking the amputation lay a yard in front of Kleweski, but it did not bother him—it just did not look real.

The overhead hatch *chunked* shut. Kleweski realized he could hear.

He never had time to even scream, he thought, still dazed.

Smells began to reach him, now that the air was no longer rushing up through the hatchway. Ozone, a pungent gas from Ouayo's breathing apparatus, scorched paint fumes from the two glowing spots on the bulkheads.

Mixed with all these, the smell of Ouayo.

Not much different from . . . well, if it had been . . . me, Kleweski thought as he fumbled for the switch to reactivate the door behind him.

He staggered through and along the corridor, listening for the door to close. With the *thump*, there returned a memory he had not been aware of—the sound of that tentacle plopping on the deck in front of him. He paused, leaned over to brace both hands against the bulkhead, and was sick.

By the time he reached the pit balcony, the shock was wearing off. He could even face the idea of going back to clean up, but his first intention was to contact the *Skrenthi*.

He stopped short at the thought.

"Now they have nobody to run the place but me," he murmured.

There was no denying that Ouayo had arranged the perfect setup. Millions to work his calculations and

tests for him — plus whatever electronic devices *they* built to make the task speedier. And their whole existence was dependent upon whoever controlled the station, the medium of their survival.

"Nuts!" he growled, shaking his head. "You're still dizzy from the shooting. That's just what you were against!"

He opened the door and strode down the short flight of steps to the screen. The *Skrenthi* were already on, waiting.

"What happened? We heard no radio message."

Kleweski explained, and described what had occurred.

"I was lucky," he concluded, "even though he didn't slip."

The *Skrenthi* looked at each other. Kleweski decided that they were considering the altered situation, wondering how to deal with him. He could see their problem. What he ought to do, he realized, was to reassure them that he would not expect too much—

Get that idea out of your head! he told himself.

But he could not help thinking of the staggering amount of research that would be possible. He visualized millions of *Skrenthi* hustling about, feeding problems into thousands of mechanical brains.

Well, that much seemed perfectly legitimate, he decided. His manner of controlling it was what bothered him.

"It was not mere luck," said the *Skrenthi* spokesman.

"What?"

"Not at all. Did we not tell you Ouayo would make a mistake if given too many alternatives to handle in a brief instant?"

"Yes, but he handled them all," objected Kleweski. "I thought he'd get caught in the empty air lock as the hatch closed and never get out again, but he pulled back. And he'd already checked or blasted every other way I could have gone."

"But you had not gone."

"No . . . but he found that out quick enough!"

"Please!" said the other. "He was *not* quick enough. Perhaps, had he chosen to check the possibilities confronting him in a slightly different order—who shall say? But the actual result bears out our careful estimate of Ouayo—and of you!"

Kleweski started to answer, but puffed out his cheeks as he caught up to the last statement. He chose to listen further.

"We are well satisfied," he was told. "We have succeeded in the very first of our planned attempts to escape from a sort of tyranny that was intolerable to us; and we have every expectation that you will aid us in the future, since our advice

has proved accurate in helping you to save your own life."

Kleweski discovered that he was relieved more than he would have expected, both at finding himself in the good graces of the *Skrenthi* and at having been distracted from making a very possibly fatal decision.

They can be quite dangerous in their own little way, he realized, deciding that they would certainly have found another tool with which to deal with Ouayo had Kleweski not been handy.

"You still want to make a business of computation and research?" he asked.

"It seems a likely way to earn our . . . living."

"Then I think," said Kleweski, "that I will just leave the terms to you. I am sure we can trust each other."

After the screen had darkened while the *Skrenthi* went to inform their people, he remained to stare speculatively at the gleaming spheres hanging serenely in the pit.

"It's the most marvelous research tool I ever heard of," he told himself at last. "I just wish I could be sure of who's the tool!"

THE END

★ ★ ★ ★ ★

THESE RARE EARTHS

BY
WILLIAM
OLCOTT



The rare earths aren't so very rare—their primary rarity is due to commonness—they have their chemical properties in common to such an extent that they were almost inseparable. Generations of PhD's worked performing 10,000 fractional crystallizations to extract one quasi-pure crystal of an element practically indistinguishable from its near-twin. And today—they're on mass production!

A group of elements which once formed the pieces of an unsolved chemical jig-saw puzzle have come into their own in the family of useful metals.

These are the rare earth elements, which for many years were considered blots on the regularity of the

periodic table. Now in new research, they have been rediscovered and put to new uses worthy of the highly individualistic elements they are.

It all started back in 1794 when a black rock was found near Ytterby, Sweden. Scientists, working with

this rock, found a new oxide, which they named yttria in honor of the place where the rock was found. But before too many years went by, they found another oxide in the previous one—this was named ceria. Ceria in turn was divided to produce ceria and lanthana, and so on until seven oxides were found in what had been thought to be the single oxide, ceria.

Meanwhile, the same sort of thing was happening to yttria. Two more substances were found in this, and these were called erbia and terbia. Some professional doubting Thomases thought there was only one oxide, and that terbia didn't exist. So then they called erbia terbia, and later when it was proved that there was a second oxide, this was now called erbia, though it was originally terbia. Then erbia—the original terbia—was divided into three more parts.

The result of this muddle was the identification of fourteen rare earths and a periodic homologue, yttrium. The fourteen included all but one of the rare earth series as we know it today:

	At. No.	At. Wt.
Lanthanum	57	138.9
Cerium	58	140.2
Praseodymium	59	140.9
Neodymium	60	144.3
(Promethium	61	147.)
Samarium	62	150.4
Europium	63	152.0
Gadolinium	64	157.3
Terbium	65	159.2
Dysprosium	66	162.5

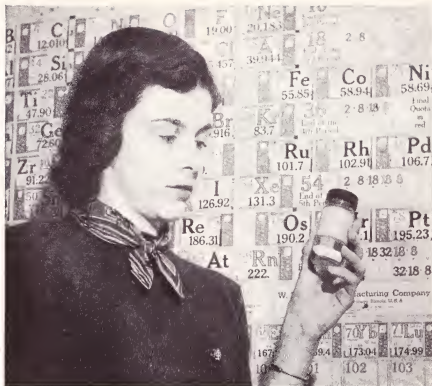
Holmium	67	163.5
Erbium	68	167.7
Thulium	69	169.4
Ytterbium	70	173.5
Lutecium	71	175.0

The "earth" in the name rare earth comes from the fact that the metallic oxides are strongly basic, and are similar to such alkaline earths as magnesia and lime. The name rare earths refers to the oxides, and the tag, rare earth metals, to the elements themselves.

The fact that there was a large group of chemically similar elements falling together was a puzzler, because, according to the periodic charts of Mendeléef and Meyer, only one element should have occurred between barium in group two and hafnium in group four. Because of this, the rare earth elements were cited for many years as an argument against the periodicity of the elements, at least in the exact form which had earlier been proposed.

Of course, the whole matter was rather academic. Not many people were worried about a group of chemically monotonous, unpronounceable elements like praseodymium and dysprosium floating around without a logical home in the periodic chart of the elements.

As time wore on, work in theoretical physics and chemistry showed the rare earths their atomic niche. Moseley, in his work with atomic numbers, showed that there should be fifteen elements between barium and hafnium. Niels Bohr's



Iowa State coed examines 11 gram sample of lutecium oxide, only sample of comporitive size and purity in the world. At present market price, this sample would bring \$1,150,000, but if it were put an sale it would undauntedly break the market.

quantum theory of atomic structure showed the reason that the elements have similar properties—the outside shell, which determines such characteristics as valence, is the same for all of the rare earths. Only difference is on the inside, in what Bohr termed the “4-f” shell. The number of electrons in this shell ranges from zero up to fourteen, with every number in between represented. Later workers have suggested that this may not be true, that

some of the numbers may be skipped and others repeated.

But then comes another argument. Physicists, looking at the spectra of the series, say that there are only fourteen rare earths, since lanthanum, with no electrons in its 4-f shell, has a simple spectrum completely unlike the others.

Chemists, on the other hand, in looking for similarities in such matters as valence, crystallization or solubilities, say there is evidence for in-

cluding lanthanum in the list of rare earths.

But even of the fourteen or fifteen elements, scientists aren't sure whether or not one of these exists in nature. This is element 61, which scientists have tried to separate ever since Moseley showed that such an element should exist.

One of the difficulties in identifying such an element comes from the fact that the spectra of rare earths—physicists' definition—are rather complicated. Some spectroscopists say that the number of lines which can be observed just depends on the exposure that a photo plate is given—the longer the exposure, the more lines you can see.

For example, a change from one configuration to another for a non-ionized sample of the metal gadolinium gives over twenty thousand new lines in the spectrum. This is true no matter how choosy one is in selecting the lines which are really new. On the other hand, if the lines are counted using only the easy choice which spectroscopists call the "J" selection rule, more than eighteen million new lines can be found.

In contrast cesium, which is located only two notches down the atomic scale from the rare earth group, gives only a pair of new lines in a similar configuration change. These complications in rare earth spectroscopy demonstrate how there could be quite a fuss over finding

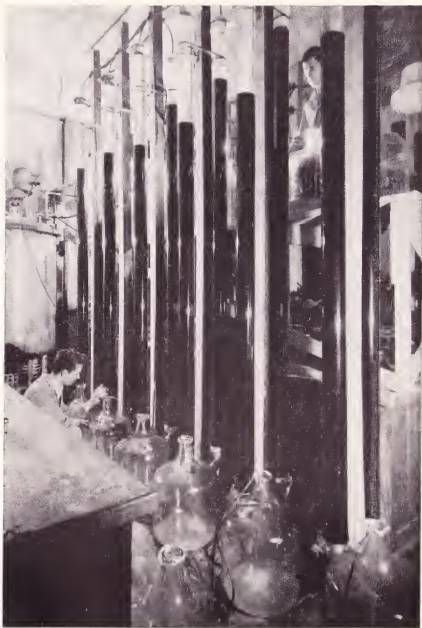
the lines which should belong to a new element.

The first rumbles of the ruckus over element 61 were heard in 1917, when a researcher photographed the spectrum of element 60, samarium, and found some lines he believed belonged to the element one notch up the scale. Some other experimental evidence seemed to support this statement, though others who tested fifty different mixtures in which element 61 should have been present failed to find anything to back up this claim.

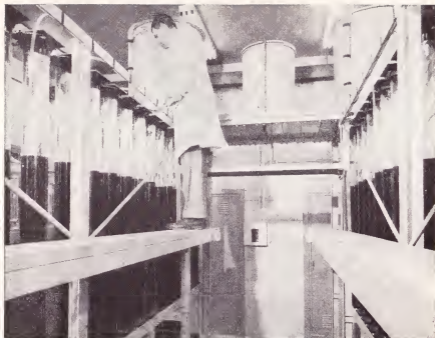
They suggested that possibly element 61 might not be a rare earth after all. It might be a homologue of manganese, instead. Other workers started out to prove or disprove this, but after working with several manganese concentrates, couldn't find anything to indicate that this was where element 61 was hiding.

Then came the year 1926, and the fury began in earnest. Harris, Yntema and Hopkins of the University of Illinois, claimed discovery of the element, calling it illinium in honor of their school. The source material they used for their discovery was a concentrate halfway between elements 60 and 62, where the new element should have been found. The trio presented three main points of evidence: new lines in the arc spectra, new absorption bands and X-ray spectra lines, with these X-ray lines closely corre-

Original setup of rare earth columns at Iowa State College where the first large-scale macroseparations were made. New laboratory equipment shown in other pictures.



THESE RARE EARTHS



Amberlite resin columns used for rare earth separation and the tubing connecting them to switchboard interchange (shown in picture on Page 83) receive final checking before rare earth solutions are put on columns. Large tanks in rear contain ammonium citrate buffered citric acid used in the separation work.

sponding to the lines theoretically predicted for element 61.

Following publication of this work, the storm descended. First, a group in Germany and another in the United States reported they had seen the lines of element 61 previously. Then came two Italian scientists, who claimed discovery of the element two years before. They insisted that the element should be named florenzium for their University of Florence.

According to how they told it,

their report of the discovery had been kept safe and sound in a locked vault since the year 1924, but they didn't explain why it had been kept under wraps.

Other careful workers could not find the lines reported, and both of these major claims—as well as the side ones—were looked upon by a majority of scientists with slightly raised eyebrows.

Element 61 is interesting from the theoretical standpoint because three rules concerning the possi-

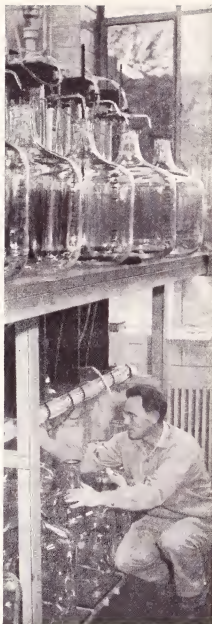
bility of stable isotopes coincide to predict that none is possible. Exceptions to these rules aren't considered true exceptions, since scientists term them radioactive substances with exceedingly long half lives.

Recently, a radioactive element 61 was separated from among uranium fission products. Because of its origin, this element was called promethium, born of fire. It is not a homologue of manganese, as once had been postulated, but instead is a true rare earth.

The reason there could be and was such an argument over this rare earth element stemmed from the fact that it used to be well nigh impossible to separate the rare earths from one another. This also was the reason that so many elements had been discovered as extra parts of previous "elements."

At the time of these discoveries, the best known method for separation was fractional crystallization. This method seldom gave more than just an enrichment of an element, and clean separations were virtually impossible for most of the rare earths.

Each element had its own specific recipe for crystallization. Maybe the bromate would best separate it from its neighbor, or possibly the double ammonium nitrate. For some, crys-



Attendant checks positions of bottles used to store different rare earth fractions after they have passed through omberlite columns. Bottles on top store solutions previous to their passage through columns.

tallization with one salt would be followed by a switch to another for the final separation.

This was a tedious process. Anywhere from one hundred fifty to fifteen thousand crystallizations were needed for separation. Good yields of relatively pure rare earths weren't obtained.

Next step in separation procedures came when scientists found that some of the elements had an extra valence in addition to the regular plus three. Cerium could be oxidized to a valence of four, while europium, samarium and ytterbium could be pulled down to a divalent state.

This helped, but fractional crystallization was still the main criterion for separation.

The first break in the search came in 1936, when two German chemists suggested separating the elements using long columns of alumina, which had been used in chromatographic separations. The name chromatographic separation came from the first use for the alumina columns, separating the different plant coloring materials.

By using these botanical standbys, the Germans were able to enrich their mixtures, but could do little more. Finnish and then Italian scientists repeated the experiments, getting better results, though the finished products were still nothing to cheer about.

Alumina, used in these early experiments, was one of a series of nat-

urally occurring compounds which could be used in these chromatographic exchanges. In addition, science was finding other natural compounds which had these exchanging properties. Fuller's earth, for example, has been used to purify gasoline and other petroleum products. Compounds called zeolites found use in softening water. These zeolites were complex inorganic crystalline aluminosilicates of metals like sodium, potassium, calcium or barium. By charging these compounds with brine, sodium ions would replace the others, making the zeolites ready for water softening use.

When water with the "hard" magnesium and calcium ions would be passed over these zeolites, they would substitute the soft water sodium ions for the hard water ions.

The demand for these zeolites grew tremendously, so chemists began to work towards synthesizing them. This they did, but they went even further by developing organic resinous compounds which could substitute almost any variety of positive ions. Negative ion exchangers were also developed, but these don't concern rare earth processing.

The development of these ion exchangers came about near the start of World War II, which brought with it the start of the Manhattan Project research on uranium fission and adaptation of it to use in weapons.

Manhattan workers found that in atomic reactors utilizing slow neu-

trons, when uranium fission occurs, atoms usually split into two principal parts of uneven weight, both radioactive. Oftentimes rare earths were included in these products, which "poisoned" the reactor by absorbing neutrons needed to continue the fission process.

Thus one of the fields of project research was the separation and identification of these products before their radioactivity died out in order to see just why they poisoned the reactors.

Using fifty-foot zeolite columns singly and in series, workers under R. G. Russell and D. W. Pearce at Chicago University came to the conclusion that almost any element found following fission could be separated. They further postulated that the rare earths found as fission products could be isolated using this method.

Groups under Waldo Cohn and George Boyd at Chicago and later at Oak Ridge* further developed this fission product separation, using synthetic resins. Their work made possible the concentration of tracer amounts of the rare earths.

Meanwhile, a group of scientists under Frank Spedding at Iowa State College, developed an ion exchange process for the separation of gram and later kilogram quantities of rare earths. Their work was with the nonradioactive rare earths, though radioactive isotopes could be separated by their processes. This method used eight-foot columns of synthetic resin exchanger, which are

loaded with a concentrated solution of rare earths. Then the rare earth ions, which have been "stuck" to the resin granules, are eluted using buffered citric acid solutions at specific acidities. This method gave the first spectroscopically pure samples of many of the rare earths. In addition, it was relatively quick, and cheap for the purity obtained.

Starting with a separation of cerium from rare earth homologue yttrium, constants have been derived for separations of the other members of the group. No natural element 61 has been found in their work.

One of the latest elements to be separated is thulium, considered one of the least plentiful of the rare earths. Because of this, workers at Ames no longer eulogize the proverbial day in June. Instead, their quotation is: "What is so rare as a rare rare earth."

Actually, the term "rare" earth is a misnomer. Cerium, the most plentiful of the group, is more abundant than tin, tungsten, cadmium or antimony. In fact, "rare rare" thulium is about as plentiful as iodine, and three times as abundant as silver.

The term "rare" first was used when the elements could be concentrated only by fractional crystallization, and relatively pure compounds were just expensive lab curiosities, available only in small quantities.

Lucetium oxide, for example, has been priced at about one hundred

dollars per milligram, making an 11.5 *gram* sample prepared by the Ames group worth about one million one hundred fifty thousand dollars. A recent newspaper story reviewing security measures at that laboratory gave the impression that this was one of the most heavily guarded items there.

"It's kept locked up," commented one official, "but it's probably one of the least guarded things we have around here. Maybe it's worth a million dollars on paper, but if we tried to sell it, it would probably break what market there is."

Besides, a practical man might ask, "what's it good for?"

That, as the quizmaster would say, is the sixty-four dollar question about most of the rare earth family.

At present, the separate pure elements are too new to have a whole string of uses, either as salts or as metallic substances. But nevertheless, a picture of the uses of rare earths can be presented without too intent a glance into a crystal ball.

To begin with, let's take that crystal ball. There's a chance that the sphere itself might contain cerium or neodymium, which have been used to rid glass of unwanted yellow color. In addition, ceric oxide or mixed rare earths might have been used to polish the glass. As such they are better than iron oxide rouge.

If we had happened to want a mysterious looking purple crystal ball, we could have got it by adding more neodymium to the glass mix,

giving a distinctive amethyst color.

Lanthanum oxide has been added to optical glass which is free of silica to make lenses with a high index of refraction and a low dispersion, especially useful in aerial camera lenses. But while the rare earths can be used to promote better and clearer lenses, they have also been used as opacifiers in enamels or porcelain glazes.

One of the largest uses of the group in the past has been in the mantles of gas lamps. A small portion of cerium or rare earth mixtures added to thorium nitrate give the luminous white glow of these mantles. Cerium has found other pyrotechnic uses—in star shells, tracer bullets, and, more familiarly, in the flints of cigarette lighters.

Ceric salts have been used as oxidizers, while cerium alloys will scavenge for oxygen in cast iron and can be used as "getters" to remove trace impurities inside radio tubes.

Rare earth oxides and fluorides are used in the center of carbon arcs to provide intense white light. The chlorides have been used in waterproofing textiles, and the oxalates in a seasickness remedy.

A new use for samarium and europium was found during the war when it was discovered that they would serve as activators of infrared sensitive phosphors. Where strontium salt crystals by themselves are not sensitive to infrared, the addition of small quantities of either of these rare earths makes it possible for one to "see in the dark." The so-

called sniperscope and snooperscope used these infrared sensitive phosphors in combination with a built-in source of infrared light. Objects in front of the scopes were flooded with this radiation, and reflected onto the phosphor.

Cerium as a metal, as well as a mixture of rare earth metals called "misch-metal," have shown similar tendencies when used in alloys. When added to cast iron, they increase yield strength, tensile strength and elongation. Grain size in the metallic structure can also be decreased through their use.

An even more important use of cerium or misch-metal will be in high temperature, light-weight alloys. Magnesium alloys haven't been able to replace the heavier aluminum materials in such applications as airplane engine parts because of some undesirable qualities shown when operating temperatures are reached.

One of the tendencies shown by magnesium alloys has been that of "creeping" at high temperatures. Creep is a metallurgical term which has to do with the stretching of metals over a relatively long period of time. When a metal part is subjected to a stress, it has a tendency to elongate as the crystal planes in the metal slide over one another.

It's possible to minimize creep by good designing, but a creep resistant alloy is a good thing to have in any case. Such an alloy has been obtained by adding cerium or misch-metal to magnesium, though this al-

loy works well only at high temperatures. It doesn't show good mechanical tendencies at lower temperatures. The addition of zirconium to this alloy gives good characteristics over a large temperature range.

The possibility of using either cerium or a mixture of metals points up one of the important features—and to some "pure" scientists, discouraging features—about the use of rare earths: For many uses, it doesn't matter how pure any specific rare earth is. A metal or a compound which is ninety per cent pure works fully as well as one which is ninety-nine point nine per cent pure—or at least, it seems to. However, when pure metals do become more available, it's possible that more specific and better alloys may be formulated.

One of the few metals other than the common and plentiful cerium which has been separated in any quantity in its pure form is gadolinium. Gadolinium seems to be the present golden-haired boy of the rare earth series because of its nuclear properties. There is a good chance that gadolinium may replace cadmium or boron steel as control for atomic reactors.

Cadmium has been used in past control work because of what nuclear physicists call its high neutron absorption cross section. The same is true, to a lesser extent, about boron alloys. With high cross sections, cadmium and boron absorb neutrons produced by fission, control-

ling the level of neutrons in the reactor, thus regulating the rate at which the reactor will operate.

Gadolinium, by comparison to cadmium, appears to be twelve to thirteen times as effective in absorbing the neutrons used in sustaining fission in reactors using thermal—that is, slow moving—neutrons.

Of course, there are a group of unpredictable factors. First of all, gadolinium and the rest of the rare earth metals are rather reactive in air—especially when there is moisture present. If gadolinium were to be used in reactors cooled by water, some type of coating would be needed around the metal to prevent reaction with water. Selection of a suitable coating would have to be done before it could be used.

Another problem is what would happen to the gadolinium when it absorbs the neutrons. First of all, would it remain an isotope of gadolinium or would it be transmuted into another element? Secondly, would it remain a metal rod or bar, or would it crumble? Possibly some other sort of a physical change might be experienced.

Chances are, if these variables can be brought under control in testing, gadolinium would be used as a rough control for a reactor, keeping cadmium for use as a fine control. Samarium and europium, which have somewhat high cross sections, could possibly be put to a similar use.

This use for some of the rare earth metals demonstrates that it is

through physical rather than chemical properties that rare earths exhibit their principal variations.

Gadolinium, in addition to possible use in reactors, shows promise of another valuable contribution to technology. This metal is similar to iron in its magnetic properties up to about sixty degrees Fahrenheit. In fact, it is more magnetic than iron at low temperatures.

This hints that it might be alloyed with iron, nickel, cobalt or other metals to produce a magnetic alloy similar to Alnico or Cunifer. At present gadolinium metal is rather expensive, so it might not be practical to use it in a magnetic alloy unless the alloy were definitely superior to other available materials. Of course, if it were a better magnet, the cost would be worth it.

Development of other uses for rare earth metals depends in part on the development of ways to get the pure metals themselves. The heats of formation of the rare earth oxides are considerably higher than those of the common reduction agents like carbon, iron or lead.

Pure rare earth metals have been produced by this thermal reduction process by heating a rare earth salt with an active metal like calcium or magnesium. These reactions, at least in their present states, are small scale operations, and not readily adaptable to factory scale.

Not all of the rare earth metals have been prepared in their pure forms using this method, and

possibly the older electrolytic method would have to be used on any not obtainable with thermal reduction. Electrolysis with a fused salt has tended to give metals not quite the purity that can be obtained using the reduction method, despite the fact that the calcium or other metal used has to be separated out after the reaction has taken place.

A new instrument has been designed to check this removal. It is a spectroscope which has a multiplier phototube attached so that it can measure the relative intensity of certain lines in the spectra of calcium and rare earth metals.

The rare earth series, as the term has been used in this article, refers just to the elements from 57 through 71, though there is actually a second rare earth series. Taking this into consideration, it's better to call the first series the lanthanides—for its first member. The second series, similarly, may be called the actinide series, since actinium, element 89, is the first of this set. The actinides extend, at present, through thorium, uranium and plutonium as well as the other transuranic elements up through number 98, californium. In theory, any element made, up through number 103, will also be an actinide.

An element in either of these rare earth series shows similarities to other elements within its own series and in the other series. Each series appears in periodic chart group IIIA, but there seem to be exceptions to some of the similarity rules

among elements in the heavier series.

Where all of the lanthanides show a valence of three, the natural elements above actinium don't show a primary valence of three, and for some such a valence is definitely unstable. Thorium, one above actinium, shows a primary four valence, while protoactinium shows a plus five and uranium a primary hexavalent form. Each of these also shows some similarities to elements appearing beneath it in periodic group four, five or six, rather than to the rare earths in group three.

But with uranium, the exceptions end. Neptunium, plutonium, americium, curium and berkelium have the expected three valence. This very likely will be true of californium and any new productions farther up the table.

One of the relations between the two series comes in a source of the various elements. Monazite sand, found in Brazil, India and Ceylon, is the principal source of both thorium and the rare earths.

Thorium, while it has played second fiddle to uranium²³⁸ in work with the atomic bomb, can be used as a source material in breeding the fissionable isotope uranium.²³³ This is believed to be substitutable for uranium²³⁵ or plutonium²³⁹ in atomic bombs or reactors.

Investigations with thorium have made for a speed-up of monazite processing, making the now by-product rare earths more readily

available. Before the war, rare earths were the main products, and thorium was a by-product.

Monazite is a particularly good source of the lighter of the rare earths, while another mineral, gadolinite, is the principal source of the heavier rare earths. Principal source of this mineral is certain mines in Norway. If you order gadolinite, the mine is opened, the required amount of mineral is hand selected and then the mine is closed again—there isn't much of a demand.

The demand might grow greater in the future as a result of new researches with these rare earth elements. Cold temperature research is one of the fields in which they may play a part.

Scientists, in examining how matter "ticks," have been investigating different materials at low temperatures, with special interest centering on what happens when materials approach absolute zero. At absolute zero, all motion within atoms is supposed to stop.

In reaching the low temperature region, scientists began by liquefying gases like nitrogen and oxygen, reaching farther and farther towards absolute zero, about two hundred seventy-three degrees below zero on the centigrade scale.

Finally, researchers liquefied the gas which boils at the lowest temperature of any gas—helium. In this manner they were able to reach temperatures quite close to absolute zero. Now the poser was how to get any lower.

In other research, it was noticed that certain chemicals would get warm when placed inside a magnetic field. When the field is removed they cool off. This was related to the cold temperature research and another notch in the cold scale was reached. Chemicals are cooled by a bath of liquid helium while under a magnetic field. Then they're insulated from the helium and the magnetic field is taken away. This cools the chemical material still further.

Here's where rare earth compounds have come into play. Gadolinium sulfate octahydrate has been used to produce a temperature only two tenths of a degree above absolute zero. Cerium sulfate, dysprosium ethyl sulfate and cerium fluoride have brought the record down to 0.09 degree. However the lowest temperature so far claimed by this method is just 0.004 degree, but this used a mixture of potassium and chrome alum.

It's impossible to find a material to use in a thermometer which records this range of temperature, so these figures are computed using Curie's law. This equation doesn't hold all the way down to zero, so these figures are based on an extrapolation of the law, and might be wrong.

By now, there's a good chance that a temperature closer to absolute zero has been reached, but if it hasn't, possibly some pure rare earth compound could accomplish this task.

Another research use of the rare earths will be made by physical chemists. For years, a group of equations which have been proposed as laws have been built up to predict such constants as disassociation or ionization. The trouble has been that there have had to be set up a set of arbitrary constants in order to get the equations to work.

Since the rare earths probably differ from each other only in the number of electrons in the 4-f shell, the availability of pure rare earth compounds presents a fine opportunity of testing these equations since only one variable is present, rather than a whole fistful.

If this experimentation proves the equations incorrect, then perhaps measurements with the rare earths will show how to determine some actual laws, giving science a better understanding of why atoms and molecules behave as they do. This is certainly one use for pure rare earths for which none of the enriched mixtures of the past could be used.

For those who work with botany, biophysics or biochemistry, the fact that all the rare earths except for

promethium, holmium, terbium and lutecium have been found in small amounts in a number of plants may hold considerable interest.

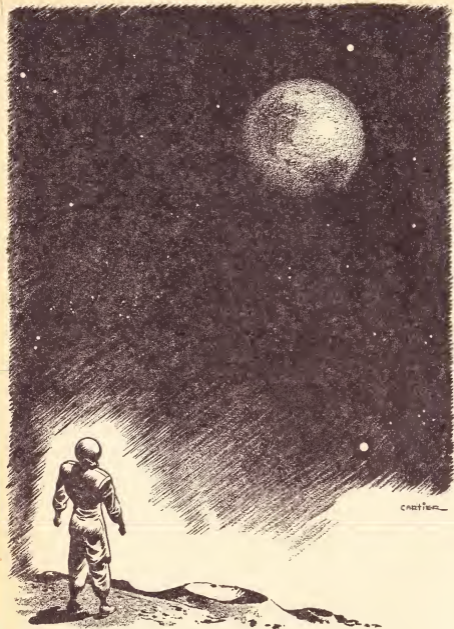
This hints that these elements may play a part in the chemistry of specialized enzymes or in other physiological uses by the specific plants.

All in all, to the "pure" scientist, the work with theoretical constants and laws, and the compatriot in investigating the structure of matter—cold temperature research—show the greatest promise for the future, first in research and then in resulting practical applications, when and if they can be found.

To the so-called "practical man," use of the rare earths in high temperature light-weight alloys or magnetic alloys might seem to be the principal horizon. The use in controlling nuclear reactors might also be listed here.

But for both the pure and the applied research of the future, in the finding of a separation of that group of chemically monotonous elements and the production of them as pure metals, man has found new cogs for the gears of his atomic age technology.

THE END



CARTIER

"THE YEARS DRAW NIGH"

BY LESTER del REY

Ever felt a keen disappointment when you're set to go to a much desired place—and find there is no place to go after all. . . ?

Illustrated by Cartier

Mars was harsh and old, worn with the footsteps of two races that had come and gone, leaving only scant traces behind. Even the wind was tired, and its thin wailing was a monotonous mutter of memories from its eroded past.

Zeke Lerner stared out from the dust-covered observation port of the hastily reconditioned little rocket, across the scarred runways and sand-filled pits for the starships, toward the ruins of what had once been the great Star Station. His face was gray and dull as he watched a figure coming across the pitted sand of the field toward his ship.

He sighed softly, a faint sound in the tiny cabin, and his breath stirred the dust that lay everywhere. In four centuries, a man can learn not to think, but feelings and emotions survive. He was tired beyond any power of the rejuvenation treatments to remedy. His shoulders sagged slightly, confirming the age that the

gray in his hair implied. But his eyes were older still as he swung about to open the inner lock of the ship.

Stendal was a middle-aged man, but some of the same age and fatigue lay on his face when he dropped his aspirator helmet and slumped limply into a seat, and his plain uniform as Assistant Co-ordinator of Terra was covered with dirt and grime. He grinned faintly at Zeke and pulled a thermo of coffee out of its niche.

"So the *Thirty-four* is coming back?" Zeke asked quietly.

He had no need of the other's nod, though. When they'd finally located him at the Rejuvenation Center and rushed him to the rocket field, he'd suspected. Only a matter of extreme urgency could interrupt a man's return to youth. The messengers had been uninformative, but he had been sure, once they told him Stendal was waiting on Mars. They must have been keeping it re-

stricted to the top administrators. Zeke's eyes went back to the dirt on the man's uniform.

"Top secret," Stendal confirmed. "So hush-hush that I came to do the janitor work here. Now it's all yours. The robots and I managed to get it into a reasonable facsimile of repaired condition. *Ooft* I could use a week's sleep, but I've got to get back Earthside at once. Sorry to interrupt the rejuvenation, Zeke."

Zeke shrugged. Once, when the rejuvenation was new and men stood in line for days to keep their appointment, it might have mattered. Now there'd be a cancellation he could replace. Over fifteen per cent of the population was refusing treatment—and some of the canceling men were ones only reaching their first touch of age. Each year, less of the population seemed to find life worth renewing.

"How'd you find out she was coming?" he asked. "After all, she's fifty years overdue."

Stendal tossed the thermo into a disposal chute and reached for one of Zeke's cigarettes. "Centaurus' automatic signal must still be working. Nigel, at the Bureau, got a series of pips showing something coming this way faster than light. That's the only ship we have out, so it must be her, or—"

He let it hang unfinished, but Zeke knew what he was thinking. It was either the *Thirty-four* or another race coming with a ship that could exceed light speed. Sudden adrenalin shot through him, and he

straightened. After all, the ship was long overdue. He wished the ship and the men no ill, but—

"No use getting up false hopes," Stendal cut into his thoughts. "The captain was a pretty determined sort, as I remember him. Maybe he had trouble. And I'll have trouble if I don't get back. I'll leave you a robot, in case anything needs more repairs. Think you can still run this setup, Zeke?"

Zeke snorted. He'd spent time enough at Marsport, first as head of communications, and finally as director of the whole Star Ship project, while they built the great ships and sent them out as fast as they could come off the ways. Forty ships during half a century, each costing over four billion dollars. And the *Thirty-four* was the last one out. All the rest had come back, report failure in this final ⁽¹⁾chance for new frontiers.

They buckled on their aspirator helmets and went out through the locks. Stendal waved curtly and headed toward his own rocket, calling three of the waiting robots with him and sending the fourth toward the broken ruin of the administration building. Zeke watched Stendal's rocket take off and disappear. Then he turned for a final look over the wrecked field.

Mars was already wiping out all traces of this second race that had come boiling out from Earth, bent for the stars. Marsport had been young and booming when Zeke had

come there first; three and a half centuries ago. Two centuries later, when the starships first began to come straggling back, and they shifted him to Earth to head General Traffic, the sand was just starting to creep over the outer buildings.

Those structures were gone now, vanished into the desert, with only this single building maintained after a fashion in faint hope the last ship would return. The frame shacks and hydroponic quonsets that had hidden the ancient Martian ruins were rotted long before; there was only the hint of a foundation here and there to show they had ever existed. In a century or so there would be no evidence that Mars had ever felt the marching feet of men, except for the scraps of the returned ships that might last a few millennia longer.

Zeke sighed again, and headed toward the building.

Then his eyes went to the horizon, where the piled stones and pitted pylon of beryl steel still stood, marking what had been the unknown and apparently unknowable race of Mars, dead perhaps ten million years before. Once that race must have spread its structures across the whole planet, but now there were only such traces as this, useless to even the archaeologists. All the elaborate designs on them might have held significance once, but no man would ever decode them. There was no hint as to their nature, or where the race had vanished—or

why.

He entered the lock of the building, with the robot dutifully at his heels, and surveyed it glumly. Only the one room, housing the great space-destroying ultrawave communicators, had been put in order. But most of the sand and dust was gone, and it was livable enough for a while. He checked to see that the communicator was working before walking over to the single window and staring out at the Martian ruins again.

Beside him, the robot stirred uneasily. "Orders?" it questioned.

Zeke turned back reluctantly from the window. "No orders, Ozin. We're on Mars, where men have given up dominion. You're as free as I am. Do what you like."

Ozin stirred again, worn metal protesting at its lack of usefulness, its queer, almost intelligent mind trying to resolve the problem presented by Zeke's words. But even this final robot, the last model before men abandoned the idea of robots, could not handle that.

"Orders?" it repeated.

Zeke gave up. "Take my ship up and house it behind the building, out of the way, then. After that, you can cut off until I call you."

The robot wasted no words in acknowledgment, but turned slowly and headed out, its metal body clumping along as woodenly as Zeke's mind was working. The lock hissed softly, and a trace of the stale, dessicated air of Mars came in.

Then Ozin appeared around the arc of the wall, heading toward the rocket. Zeke watched it enter, saw the shiplock close, and shut his eyes at the deep blue flame of the exhaust from the unbaffled tubes.

Sand kicked up, spurting out and grating against the walls of the station wing, swishing against the pylon of the lost Martians. For a minute, dust hung in the air. But it settled back quickly now, to show an unchanged scene. Zeke heard the ship land again behind the building.

He reached automatically for a cigarette, wondering idly if the repaired building aspirators would take even that much added load in their labor of making a decent atmosphere out of Mars' thin air. For a second, he fiddled with the ultra-wave set. The signal was coming through from Earth, indicating that they were already quietly beaming it out to where the *Thirty-four* could pick it up. It was the same dull, insipid news Zeke had heard for too many decades, though it might be interesting to men who had been gone from Earth for over two centuries. There was no other signal to indicate that they were within calling distance, however.

He went to the window again, to watch the slow sinking of the sun that was reddening a distant sandstorm, until it finally crept below the horizon. With an abruptness that was typical of the planet, darkness fell. The stars seemed to leap into the sky, with Earth standing

out among them. He frowned at that, realizing that he was the only man who would be seeing it. All the others were home on the planet.

The skylight was filthy, but he found a battered bench that would stand his weight and began working the dust and grime from the glass. The stars were clearer through that. A few hundred years hadn't changed them noticeably, and he picked them out—hot points that barely flickered in the thin air of Mars. Jupiter was in view, and he knew where all the other useless planets should be, though he could not see them.

He grimaced faintly at that, remembering his life as a boy when men had dreamed that each new world might contain some rare treasure—or even intelligence to meet and compete with man. None had panned out, though. Mercury was too hot, Venus was a roiling dustbowl under foul, poisonous layers of atmosphere, Mars worn beyond usefulness, and the other planets too cold and forbidding, except as possible stepping stones to the stars that lay farther out.

Chenery had found the trick to beat light speed when Zeke was still a callow thirty, and Marsport had sprung into life; the planet had made an ideal take-off point for ships which Earth could not permit in her own atmosphere because of the dangerous radiation of their exhausts.

There'd been Centaurus and Sirius, and the thousands of suns be-

yond, some with planets and some without. There had even been the high moment when a planet had been found and colonized, a mere thousand light-years away, before men had discovered that something in the star's radiation was eventually lethal to all Earth forms. But there had been no life beyond the Solar System—and nothing that even the most foolhardy could use as a reason for man's settlement.

It had proven to be a barren universe, except for Earth and the Mars of perhaps ten million years ago. Zeke looked at the ruins again, still faintly visible in the light that sliced out from his window. Whatever had built them had reached a civilization at least as high as man's. What had happened to them that had made a culture capable of such work come to a sudden and unmarked end?

A meaningless crackle came from the ultrawave set, and he moved to it, touching up its sensitivity. For a moment again, he hoped that it would respond with only gibberish that might mean another race coming down the long starlanes toward Earth, instead of the code he knew. But he choked off the wish, even before the speaker burped again. There was a sudden sound of code symbols a second later, followed by the thin, wavering words and voice at the limit of reception.

"Star-Ship *Thirty-four* coming in. Can you get us? *Thirty-four* calling Marsport. Landing in two hours

maximum. Clear field for full splash landing. Clear field for landing without tube shields. *Thirty-four* calling Marsport—"

Zeke had the great bank of accumulators working through the transmitter, and the indicators showed that the big tubes were ready to throw their pulsed megawatts into subspace. He glanced at the bandpass and saw that it was at its maximum intelligibility level for the distance.

"Land Marsport, *Thirty-four*, as you will. All clear. Repeat."

The voice came back, weaker. It wavered, broke into a squeal, and disappeared in a hash of static. Only blind luck had given them clear subspace long enough for a complete call. Zeke cut off the transmitter; there was no purpose in telling them that the field had been clear for decades. They'd find that soon enough.

Mars had still been a colony when they took off. It had remained one while six more of the great ships were built and sent out with orders to proceed to the limit of range before returning—or to return on significant discovery. Zeke had watched them all leave, filled with bright young volunteers, sure that they would be the ones to find a new race of intelligent life or a world that would be a paradise for men. Now the last one out was returning, and it was appropriate that he should meet the space-weary men who were coming home.

He tried to remember them, but

there had been too many years and too many ships. On impulse, he knocked dust from the walls, scanning the names that had been scrawled there against regulations—and left because he had countermanded those regulations. Surprisingly, he found the one he was seeking. Hugh Miffen, captain of the *Thirty-four*. Zeke remembered him now, a tow-headed boy with a ramrod back and the driving urge of divine inspiration in his eyes. And there had been "Preacher" Hook, who swore he was going to memorize the whole Bible in subspace. Only the two stood out now, over the long years.

Surely, if any group could have found a home for man or a companion intelligence, that group should have done it. *Something* must have happened during the fifty years they had been overdue. Their fuel would never have lasted, otherwise.

The speaker gobbled at him, finally, until he cut the power down. The wash of static could only mean that they were beginning the struggle out of subspace, knocking a hole for themselves in normal space and crawling painfully into it. It was taking the ship longer than it should, and Zeke began to worry. Then the blare of static decreased. He knew she was down under light speed.

The ship robot took his call this time, indicating that all the men aboard were fully occupied in the

task of trimming her for normal flight. The signal was clear, however, and he could hear faint sounds of men's voices in the background. There was no undue worry in them, as best he could tell.

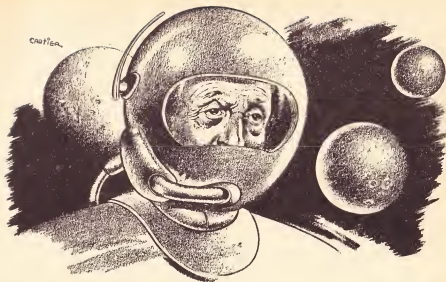
"Sealed beam," Zeke requested. It took more power to maintain a signal that could be handled on a beam with the ultrawave, but she was close enough now to risk it; it wouldn't do to have the message accidentally picked up by Earth until he knew what the results of the trip were. The robot acknowledged his order, and the queer, clipped effect of the sealing could be detected on the signal.

Zeke grunted with satisfaction as he made his own adjustment. "O.K., this is Zeke Lerner, code responsibility 21-zy-18-obt-4-a. You can report."

"Digest of report," the robot began tonelessly. "Visited suns, 3248; examined planets, 2751. Checked suns on automatic spotting, 9472; checked planets and found barren on automatic spotting, 23,911. Maximum distance attained by direct route, one hundred ten thousand light-years, forty-three ship-years; arc of coverage—"

"Cut it out. Did you find inhabited worlds?"

The robot adjusted to the interruption slowly, humming into the microphone as evidence that it was still there. Zeke swore. Then a human voice suddenly took over, weary even through the distortion of the sealed beam.



"Lerner? You still on the spot?"

It was a deep bass voice that could only belong to Hugh Miffen, in spite of the years that had roughened it. The ship had naturally carried rejuvenation equipment, but even the best treatment never wiped out all traces of time. "Sorry we had the robot on—it's about half shot, now. Anyhow, we're under light, and I'm free for a minute. Leaving out the statistics, we ran out too far and got short of fuel. We'd spotted two planets that might barely be habitable, so we backtracked and put down on one of them. It took us about thirty-five years to find and work fuel out of the ores. Then we went on a bit before we turned home."

Zeke's eyebrows had shot up, and

he shook his head. He tried to picture what it would be like on some barely livable planet, scouting for ore, jury-rigging some kind of plant to refine it—with almost no equipment—and his old respect for Miffen went up another notch. That type of man seemed sadly lacking nowadays. But he made no comment on it; it could wait for more important things, and Miffen had begun to describe the two planets.

One was too far from its sun in an eccentric orbit, going from a brief summer into a bitter winter equal to three years of Earth time. It was suitable otherwise, but no more so than Antarctica. The other was a waste land of little water and low air pressure, though barely habitable. It had been on that world that

Miffen and his crew had stranded themselves. Zeke frowned as he discarded the planets. Both would mean tremendous difficulties in ferrying supplies out for at least a century until they could somehow be made self-supporting. Men would work for a dream, but there were limits. It would need more incentive than there seemed to be.

"Evidence of life anywhere?" he asked reluctantly, as the other finished. But the question had to be asked, although the answer could be predicted, almost certainly. Even over that distance, the possibility of other races to study might drive the scientists to set up an outpost, and with that as a basis, another world might be developed as a stepping stone to still further exploration.

Miffen's voice was hesitant as the answer came. "The world we were on—Outpost, we called it—had some ruins that could only come from intelligence. But there was nothing living there. Maybe it had been what we called it once—Damn!"

A yell had sounded thinly over the speaker. Miffen's steps clattered loudly, to fade out, and leave the ultrawave dead. With the ship braking down for a landing, there was probably more than enough work for all the men. Zeke's hand lingered over the switch. Finally, he depressed it, cutting off power.

Ruins that showed intelligence, eighty million light-years across the galaxy! In forty thousand explored

worlds the starships had touched, this was the first sign of even that much chance. It wasn't enough, of course, but—

Slowly Zeke's shoulders straightened and his figure came erect. They'd explored space to a distance of a hundred million light-years on a bare chance, without any reason to hope. Out of all the previous reports, there had been only three habitable worlds, and no sign of life beyond the Solar System. Now a ship was returning with reports of two barely possible worlds and evidence that there was such life! An outpost—and somewhere beyond, perhaps, the planet where that life still existed.

With proper propaganda, with enough build-up, and with evidence that somewhere in the infinity of stars life and livability must exist, could man refuse to go on with his questing?

For a moment, he clutched at the hope. It had to be. One world was not enough for a race that had set its heart on the stars, had always found frontiers, and had geared its soul to an eternal drive toward something beyond. It could not be cooped up and fenced in without sickening in its own futility, as it was sickening even now—as he was sick within himself after four centuries of following blind alleys.

With only a little spark to fan the flames, men might be driven on. And perhaps only a few light-years away from the end of their explorations—the arbitrary limits imposed

by time and energy for the ships—there might be fellow races to stir the spark that was dying in mankind.

Then he grinned bitterly and looked out through the window, turning the single workable searchlight on the Martian ruins. Man had found evidence of other life in his own backyard, and it had carried him for centuries. But it was not enough to drive him onward forever. There was nothing on Outpost that couldn't be had here—and no colony had lasted on Mars.

Zeke squinted his eyes as he studied the pylon again, noting the queer, twisted decorations on it. He had seen the report of the scientists, and they had finally given up the riddle. It would take more than this to drive men further outwards. And Miffen's voice had sounded too doubtful.

But some of the hope remained faintly in him as he stood staring into the Martian night. It would have to wait until he heard more. Now it was only another mystery, like that of the lost race of Mars.

What had happened to them? They had known how to cast tungsten, and there was evidence that nuclear reactions had been used in tempering the pylons. That was high level science. Where had it gone? There had apparently been no long period of high civilization, since the pylons all over the planet were about alike, with few advances in the later ones. There hadn't been time enough for the race to become

decadent. Nor was there any evidences of war carried on by a race with advanced nuclear physics; there would have been enough signs of that. They couldn't have settled Earth, of course—it wouldn't have been suitable. But they must have had starships. What had kept them from spreading outwards—had even wasted them into nothingness in such a brief period of culture on their own planet?

His thoughts were interrupted by a *beep* from the speaker, and he switched on the automatic ultra-wave beacons that would guide the ship down. Overhead, a thin whine thickened to a stuttering cough, the unhealthy sound of gasping, unshielded rockets that had been used too often and in too many futile landings. It was coming down well enough, though, half a mile away. Zeke watched it land while he was climbing into antiradiation armor.

The ground was still smoking, but the counter showed the radiation low enough for a quick passage when he went out. He waited for the outer lock to open, then made a dash toward it, his breath reminding him that he was old and had not been rejuvenated. He crawled into the lock and stopped to catch himself before removing the armor, while the inner lock began to open.

Then he was facing four gaunt, weary men. His eyes darted back for the others of the thirty who had gone out, but Miffen was shaking his gray-bearded head. "Four of us,

general. We had a few casualties. But—"

His arm swept out toward the field, now illuminated by the beams of the great ship, and his eyes fixed on the scene of the sand-filled pits and bits of building foundations that showed through the quartz of the entrance port.

Zeke shrugged and reached for his cigarettes. The sudden hunger in their eyes hit him, then, reminding him of stores now depleted in all those long years. He passed the package around, careful not to notice the hands that shook as they pulled out the cylinders.

"We've had some casualties, too, you might say," he told Miffen. He lighted his own cigarette finally, and his shoulders lifted and dropped at the other's expression. "And I'm not a general now—not since Marsport was abandoned. I came out only because we were expecting you back. What about Outpost?"

"In my cabin I've got it on micro-film," Miffen swung about, waving the three crewmen off. For the first time, Zeke noticed that one of them had the flaming red hair that had always distinguished Preacher Hook.

He lifted an eyebrow and Hook nodded, pulling out a worn Bible and making a circle with his thumb and finger. "All memorized," he stated. But the grin on his face was uncertain, and the achievement no longer seemed to be important to him.

Zeke had forgotten the size of

these starships as they went up the handrails. The elevators were obviously not working. Miffen swung up the last and turned into a little cabin, kicking the door farther open. He dug into a worn chest and came out with a small package and a little viewer.

"I figured some things from what we picked up of Earth's broadcast," he remarked emotionlessly as he threaded the film into the viewer. "But I didn't believe it. Not until I saw Marsport. I guess . . . Well, this will give you an idea of Outpost. I explored all the suns around I could reach, but I never learned where the race originated."

Zeke adjusted the lenses carefully, seeing the unfamiliar two-dimensional flatness of non-stereo for the first time in centuries. It was awkward at first, but his eyes soon relearned the trick of fooling themselves.

There were several scenes, showing a sky of dull green, with grayish sand and something that looked like jumbled blocks of granite. As he stared, a pattern began to show itself. Something had been built there once, and by intelligence. Closer viewing showed that the stones had been shaped geometrically, under all their weathering.

He came to a list of statistics and skimmed through it. Then he reached the final scene.

Miffen's voice suddenly sounded behind him, awkward and too tense. "What about the other ships?"

"They all got back—they're piled

up beside the field, beyond the reach of your lights. No use to us now. Thirty-nine hulks, and yours makes the fortieth—all we ever built." He turned back to the film, but again Miffen's voice interrupted him.

"All? I'd expect it—That bad, eh?"

"Worse. I suppose you're entitled to know what you've come back to. You'll see it soon enough, though—and better than I can tell you." Zeke clamped the viewer to his eye firmly, and turned to the light once more. "There was purpose when you left. Now that's all past tense."

"Yeah." Miffen let the word hang. He must have seen Zeke's sudden tenseness and realized there was no use putting off the inspection of the final scene on the film any longer. Zeke was still staring at it, but he was unconscious of what his eyes saw, and the last of the hope in him was draining slowly away.

He stared up at Miffen, tapping the viewer. "You know what this is, of course. Or do you?"

Miffen shook his head. "I suspected. But I never paid much attention back here, and it's been a long time. I kept hoping I was crazy."

Zeke made no answer. He picked up the viewer and headed toward the control room, with Miffen following. Still silent, he pointed out through the viewports, across the leprous surface of Mars, toward the pitted beryl steel pylon that

gleamed in the light from the Star Station. Then he put the viewer to his eyes again.

The sky was green instead of black, and the sand was gray where Mars was covered with red. But the scene was the same. A gleaming metal pylon rose from the rubble of ruined blocks; carrying the queer, twisted decorations that had been typical of all Martian structures. There was no question about what race had tried to colonize Outpost—and had failed.

Suddenly a work-gnarled hand took the viewer from him, and he turned to see Preacher Hook and the other men. They must have followed Miffen and himself into the control room. But it didn't matter. They must have suspected. And there was no surprise on their faces as they passed the viewer from one to another, comparing the scene with that outside.

Almost without feeling, Zeke picked up the ultrawave microphone and called the administration building, ordering the robot to bring his rocket down beside the big starship. He adjusted the dials carefully and spoke terse, coded symbols into the instrument. A moment later, Stendal's voice answered him.

"I'm bringing the four survivors down in my ship," he reported in a voice that seemed completely detached from him. "Give us a secrecy blanket until we can report in full. And see if you can fill a few bathtubs with whisky. We'll need it."

Stendal seemed to catch his

breath and then sigh, but his words were level when he spoke. "So Pandora's box was just a fairy story, after all. Well, I never had many hopes. O.K., I'll get the liquor, Zeke. And about your rejuvenation—I'm getting a private installation here for you. If the others need it, we'll take care of all of you."

Zeke looked up at the four men, and then out toward the pylon again—all that was left of a race that had searched the stars in its need to find new frontiers. It must have been a hardy race, since it had dared to set up a colony across all those innumerable parsecs of space, without even the inspiration of other life. Then, when that colony had failed, the race had returned to the loneliness of its own little world, where the stars looked down grimly, no longer promising anything. Now Mars had been dead ten million years, and the pylon stood as the final tombstone on the world which had become a prison. The old puzzle of that race's end was solved.

The speaker was sputtering with

Stendal's impatient questions, as Zeke and the men studied each other, but they gave no attention to it. Preacher Hook sighed, breaking the silence.

"*Man goeth to his long home,*" he quoted softly. "*And the mourners go about the streets; or ever the silver cord be loosed, or the golden bowl be broken, or the pitcher be broken at the fountain, or the wheel broken at the cistern; and the dust return to the earth as it was, and the spirit return unto God who gave it.*"

Zeke nodded and picked up the microphone.

"Just get the whisky. We've decided to skip the rejuvenation."

He put the microphone back on its hook carefully and headed toward the handrails that led down, with the others behind him. Ozin had the rocket waiting, and they climbed in and strapped themselves down.

Then the rockets blasted, and the last five men beyond the Earth were heading home.

THE END

* * * * *



ULTIMA THULE

BY ERIC FRANK RUSSELL

There are some men who would hold to the routine of their lives, rigidly and seemingly mindlessly, beyond the very end of things, beyond space and . . .

Illustrated by van Dongen

The rocket came shivering out of hyperspace and solidified. Metallic coldness slid over its surface, starting from the prow, spreading to the tail. The pale ghosts of forty main propulsors were the last to gain concrete form. They hardened, were a quadruple ring of tubes ready to blast eight miles of fire.

Lawder, peering through the bow observation port, wiped his eyes. He had been there much longer than usual, much longer. A nervous hand put out for binoculars. The high-powered glasses could not have been of much use, the way they shook. He put them down, wiped his eyes again.

"What's eating you?" Santel was watching him. "Something wrong?" "Plenty."

It brought Santel upright, run-

ning long fingers through red hair.

He stalked to the port, stared through.

"Well?" invited Lawder.

"Impossible!"

"Ha!" Lawder said.

Santel tried the binoculars, resting wrists on the port's thick rim to steady the field of vision.

"Well?" Lawder persisted.

"Impossible," maintained Santel.

"You deny the evidence of your own eyes?"

"First impressions can be misleading."

"We're lost." Lawder sat down, viewed his boots without seeing them. His thin face twitched. "Lost souls."

"Shut up!"

"When I was a kid I once put three flies in a bottle. Then I rammed home the cork. That's us, flies in a bottle."

"Shut up!" repeated Santel more loudly. His red hair was stiff, bristly. He had another look through the port. "I'm telling Vanderveen."

"I threw the bottle in a lake. That was thirty years ago, several fly-lifetimes ago. In a lake, cold and dark, without a shore. They're still there maybe. Still there, corked in."

Switching the intercom, Santel spoke into its mike. His voice was hoarse.

"Captain, there's something funny. Better come up and see."

"I can see from here," boomed the loud-speaker.

"Huh?"

"There are four windows in this

navigation room. They are there to be looked through. I have looked."

"What do you make of it?"

"Nothing."

"Lost," murmured Lawder. "Become as if we had never been. Another lonely line on the list of missing ships. Memories that thin with the years and eventually drift away."

"One can only make nothing of nothing," said Captain Vanderveen. "Who's that mumbling in there?"

"Lawder."

"Who else could it be?" shouted Lawder at the loud-speaker. "There are only we three. All together and all alone. Just three of us. You and me and Santel."

"How can three be alone?" inquired Vanderveen gently. "Only one man can be alone, or one woman, one child."

"Woman—we'll never see one." Lawder's knuckles were white. "Child—we'll never know one."

"Take it easy," advised Santel, looking at him.

"There's a quart of Tralian alodine in the second drawer," came Vanderveen's voice. "Give him a double shot. I'll be along in a minute."

Lawder gulped it down, breathed heavily. After a while, he said, "Sorry, Santel."

"It's all right."

"Sort of shook me up a bit."

"I know."

"You don't know." He showed the signet ring on his left hand. "She gave me this two months back. I

gave her pinfire opals from Procyon Seven. We were to be married soon. This was to be my last trip."

"So!" Santel's eyebrows lifted slightly.

"It will be my last all right!"

"Now, now," soothed Santel.

"My last, forever. She can wait, watching the calendar, haunting the spaceports, scanning the arrival-lists, hoping, praying. She can grow old and gray. Or find someone else. Someone who'll come back to her, laughing, with gifts." His hand went out. "Give me that bottle again." He gurgled lengthily, held it up, eyed its dark glass. "Flies. That's us."

"Your childhood conscience is biting back at you," Santel diagnosed. "You shouldn't have done it."

"Didn't you ever cork them in?"

"No."

"Or pull off their wings and watch them crawl?"

"No."

"You're lucky."

"So it seems." Dryly, Santel nodded toward the port.

Vanderveen lumbered in—a huge man, portly, with a great spade-beard.

"So you have gazed through the windows and do not like it." He was probably the only experienced deep-spacer who persisted in referring to observation ports as windows. "You look only through these and not through the others. How silly."

They reacted eagerly. "You have

something, captain?"

"Nothing. Through every window it is the same. There is nothing."

They relaxed, disappointed.

"There is now only one unobserved direction," he went on. "That is tailward. One of you had better put on a spacesuit. No need to go through the bow lock. The main drivers are cold and will give direct rearward view."

Santel dressed himself. They tightened the neck-bolts of his helmet. He went out.

Every sound of his motion could be heard throughout the ship, faithfully conducted, a little amplified. The clump of his boots. The clang of the engine room's air-tight doors. A thin, shrill whistle of air being pumped away before he opened the inspection-trap of a vacuum-filled combustion chamber. Slithering noises, outward then inward. All the former sounds reversed.

He returned. They knew the answer before they unwound the neck-bolts. It was depicted on his face behind the armor-glass visor. The helmet came off. A dampness lay over his forehead.

"It's a heck of a lot worse when you look straight out at it." Santel split his suit down the front, wriggled like a crab escaping its shrunken shell. "And it's wrong, terribly wrong."

"Blackness," chattered Lawder, flourishing his bottle. "Sheer, solid, unrelieved blackness. Not a spark. Not one gold or silver gleam. Not a

pale pink rocket trail. Not a phantom comet."

Vanderveen stood by a port, pawing his beard.

"No suns, no planets, no green fields, no singing birds," Lawder went on. He poured generously down his gullet. "The Lord hath given and the Lord hath taken away."

"He's getting drunk," warned Santel.

"Let him." Vanderveen did not look around. "He to his inward comforts—we to ours."

Santel said steadily. "Maybe I'm slower on the uptake. I don't yet feel ready for despair."

"Of course not. You're an engineer and therefore have an engineer's mind. You know we can try the hyperdrive and chance where it takes us. Or the rockets. We have vanished from the ken of men but we're not yet beaten."

"Yeah, the hyperdrive." It hit home in Lawder's brain. "Twenty light-years in one hour. That will save us. What gets in can always come out." He grinned around, momentarily happy.

"Like an airplane plunging into the sea," suggested Santel. "Gets in. Doesn't like it. Up she goes."

Lawder swayed close to him, a glass bludgeon in his grip, swinging it hot-handed.

"You don't care if we rot here for ever. What've *you* got to go back to? One lousy room in a stinking hostel for lousy spacemen. A month ashore picking your teeth and snor-

ing through a library of slumber-educators for the big-ship rating you'll never get. Living and longing for the spaceways that will land you no place when your day is done, and—"

"That will do, Lawder," snapped Vanderveen.

"As for you—" Lawder turned on him.

"THAT WILL DO!" Vanderveen's beard stuck out. His big hands were bunched.

Savagely, Lawder swung the bottle, sobbing, "Talk to me like that!"

The captain grunted deep down in his chest, thrust out a huge paw. No more. He did no more than that, but it sent the other headlong across the room.

Silence. They stared at the body slumped in a corner, eyes shut, breathing slowly and without sound. Turning, they looked through the port. Silence. Blackness. No faraway lanterns. No faint, aureate glow of a Milky Way. Only the utter deadliness of the day before Creation. They were bodies on a forgotten barge becalmed in an ageless, endless sea. A sable sea. Dark and peaceful, as death.

"Spacemen don't get that way." Santel jerked a thumb toward the corner. "He can't be normal."

"He has someone waiting. That means much."

Santel cocked an eye at him. "What of you?"

"I'm not soon to be married." The captain viewed the dark, seeing

only the past. "Besides, I am different. You are different. That is our beauty as men, that all are different. Each does his best with what the good Lord has given him. He can do no more."

"No, sir," agreed Santel, very respectfully.

Lawder came round after a bit, blinked blearily, made no remark. Crawling into his bunk, he snored for four hours. He awoke, had a look at the chronometer.

"You guys been standing there all that time?"

"Most of it."

"Gaping at jet-black nothingness? What good will it do you?"

Santel did not bother to answer.

"We've been thinking," said Vanderveen. "Hard."

"Yeah?" Lawder crawled out, stood up, tenderly felt around his chops. "Who socked me?"

"Maybe I did. Or maybe Santel did. Or maybe you conked yourself with that bottle you were waving around."

"I get it. Nobody's telling."

"So long as I'm captain there are going to be no recriminations, no animosities. Not while we're stuck in this fix. We're too small a bunch, too alone."

Lawder eyed him, licked dry lips. "I guess so. Well, I'll go get me a drink. I feel dehydrated."

"Easy on the water," advised Vanderveen.

"Huh?"

"There is only so much."

Easy on the water—there is only so much. That was today, the first day. Tomorrow, next week, next month—what? Rationing by count of drops, every one more precious than its predecessor. Each man's measure watched by other eyes, lingering on every glistening globule, seeing it stretch, drop, and hearing its sweet, delicious *plop*.

And three minds growing increasingly bemused by the simple mathematics of the situation: a two-way split goes farther than a three-way deal. Higher calculus: all for one is more than for two. How much consumable blood in somebody else's body? Would the biggest one hold the most? How many warm pints in Vanderveen?

The captain's gaze was on him as he went for his drink. It would have been easier to bear had it been accusing, suspicious or threatening. But it was not. It was cool, calm, courageous. That made it hard, so hard. Lawder contented himself with a mere suck rolled around his mouth. He came slowly back.

"Are we going to squat here until we're mummified? Why don't we take to hyperdrive again?"

Vanderveen's thick finger pointed outside. "Because we don't know which way to shoot. Direction is a path relative to visible things. There is nothing visible, therefore no means of relating ourselves to anything, no sense of direction."

"We know how we're sitting. All we need do is back out along the line we came in."

"I wish it were that easy." If the captain was worried he did not show it. "We don't know how we're sitting or even whether we are sitting. We may be motionless or not. We may have rotated a hundred times, longitudinally or axially, and remained unaware of it. We may be skidding some place in a straight line, at high velocity, or we may be spiraling around an enormous radius. There's just no way of telling."

"But the instruments—"

"Were designed for the space-time continuum in which they were made. Right now we need *new* instruments for a totally different set of circumstances."

"All right, I'll give you that. But we've still got the hyperdrive." Lawder gestured urgently. "It can jerk us through four successive layers of hyperspace, four co-existing universes. They won't all be blotted out like this hell-hole. They'll have lights, beacons, calling us home."

"Beacons," echoed Santel moodily. "One red dwarf, old, sterile and planetless, would look like heaven to me."

"We can try, can't we?" insisted Lawder. "Can't we?"

"We can." Vanderveen was thoughtful, reluctant. "But if we choose wrongly—"

"We'll be another mighty jump still deeper into the dark," Santel finished for him. "Then we'll go nuts and make another, and another. Getting farther and farther

away trying to get nearer. Struggling harder and sinking deeper like flies trapped in sticky beer."

"Flies!" Lawder shouted it at the top of his voice. "You throw those up to me? Why, you—!"

Vanderveen moved forward, almost touching him chest to chest. "Be quiet! Listen!" His fingers combed a moment at his great beard. "We have a multitude of choices. Right, left, forward, backward, up, down and thousands of intermediates. Plus the other co-ordinates which make the number of chances a string of figures ten yards long. Only one of those may be correct. Only one may be salvation, life, home, the green fields, the friendly sun, the warmth and fellowship of other men. Any of the others may make confusion worse confounded, our damnation more damned. Do you get that?"

"Yes." It came out in a whisper.

"Very well. Give me a direction and we'll try it."

"Me?" Lawder was shaken. "Why me?"

"You're the bellyacher," said Santel.

The captain turned on him. "That was unnecessary." Again to Lawder, "Go on, choose!"

"How?" Lawder stalled for time, fearful of error.

"Point." Vanderveen's lips uttered it again, commandingly. "*Point!*"

Perspiring freely, Lawder stuck out an arm at random. It was like signaling the death trap to be

sprung.

"Give me a three-figure number," Vanderveen ordered.

"237."

"A letter."

"B."

"And an angle."

"Forty-seven degrees."

To Santel, "You heard what he said. Set them up along the line he picked. Switch immediately you're ready."

Ceremoniously, Santel dragged a tiny woolen monkey from his breast pocket, patted it three times, kissed it once and stuffed it back. He sat at the control board, adjusted it, switched.

The others stood waiting as if it were normal for the hyperdrive to be subject to delay. It was merely that its unexpected lack of response took some time to sink into their minds. Not a shudder, not a shake. No queer, flesh-tingling twist such as always accompanied ultra-rapid transition from one scheme of things to another. Not even the faintest tremor in the fabric of the ship.

Scowling to himself, Santel set the controls anew, tried again, reset, had a third go. He disappeared into the engine room, came back after twenty minutes, tried the controls.

"It won't work." His face came round over one shoulder, showing features strained and mystified. "There is nothing wrong with the apparatus. Everything is as it ought

to be. Yet it doesn't function."

Lawder burst out, "It has *got* to."

"In that case," suggested Santel, leaving the board, "you make it function."

"I'm not the engineer. That's your job."

"Well, I've flopped on it. I can't put right something that isn't wrong. I can't cure mechanical or electronic faults that don't exist. See if you can do better."

"Let me try." Vanderveen pushed past, sat at the board, patiently set up a dozen series of coordinates. He switched each one. The vessel did not stir. Its ports remained black and blank as if immersed in soot. "No luck." He arose heavily, without emotion, but looking somehow aged and tired. "The drive is out for keeps."

Santel raked his red hair. "I don't like this, captain. Hyperdrive operates from space to space. In theory, there is only one place where it could not work."

"Well?"

"And that place is purely imaginary."

"Well?"

"Unspace, or not-space, or whatever you care to call it. Somewhere devoid of spatial properties."

"Bunk!" Lawder chipped in emphatically. "Everywhere has got to be within one continuum or another. Where could not-space be?" Vanderveen said, "Outside the whole of Creation."

Momentarily it hypnotized both of them. They stood there, side by



side, viewing him with dazed eyes, their thoughts stirred to turmoil, their tongues locked and growing dry.

Finally, Lawder found voice. "The big boats can go faster and farther than us. They can cross gulfs between island universes, hyper-spatially. They've skipped from one galaxy to another and found more beyond. Always there are more beyond, sparkling in the dark. Creation has no limits."

"Hasn't it?"

"No," declared Lawder flatly.

"Can you *think* of it without limits?"

"The human mind can't really

conceive infinity. So what?"

"So you're dogmatically asserting that which you cannot conceive," Vanderveen studied him beneath thick brows. "Not that that proves or disproves anything."

"Do some proving of your own," Lawder invited. He was getting excited as his mind absorbed the dreadful implications of the captain's viewpoint.

Vanderveen said quietly, "The hyperdrive is extremely efficient when it works, but it's not one hundred per cent reliable. It operates in and through any space. Here it does not work. Neither is light transmitted anywhere immediately out-

side this ship. Neither does the radio respond."

"The radio!" Lawder smacked his forehead in self-reproof. "I forgot it."

"We tried it while you were snoring. It remains as silent as the grave." Clasp ing hands behind him, the captain paced the room. "We are some place that is not space as we understand it. Somewhere cold and sterile. Somewhere devoid of all gravitational and electromagnetic phenomena. That which stands outside of all creative forces. Negativity. Ultima Thule. The place that God forgot." He stared at them, his beard sticking forward. "The hyperdrive hit a rut and we got tossed right out of mundane existence."

"That's how it's beginning to look to me," Santel admitted.

"All the things with which we are familiar—light, gravitation, air, food, warmth, company and so on—are confined within this vessel. Outside is nothing—except, possibly, faraway and buried deep in the dark, the forty-odd ships which have vanished without word or trace in the three thousand years since hyperdrive came into general use."

"Gone forever," droned Santel, finding morbid pleasure in it. "Forever, forever, amen!"

Lawder declaimed furiously, "We'll show up. We'll come driving back in a blaze of glory. We won't stay stuck until kingdom come. Do you know why?" He glowered at one, then at the other, inviting con-

tradiction. "Because I'm going to start the rockets."

"Useless," Santel told him. "One hour of hyperdrive covers more distance than the rockets could make up in twenty years, even if the fuel—"

"Damn the fuel! May you both burn with it!"

They were silent. Their eyes followed him as he took the pilot's seat, operated the injectors, pressed the firing stud. The ship roared and shuddered.

"See?" He came out of the seat, yelled above the noise, did a little dance of triumph. "See?"

"See?" shouted Santel even louder. He pointed to the meters. Their fingers quivered in sympathy with the vessel's trembling, but that was all. No forward thrust. No velocity. No acceleration rate. Only the thermometer responded. It began to climb rapidly. Warmth poured forward from the tail end, there being almost no radiation outward.

"Cut it off, Lawder," commanded Vanderveen, anxiously noting the rise of the red line. "Cut it off. If it goes on too long we'll be roasted alive."

"Roast," howled Lawder, doing a crazy jig and ignoring the meters. "Who cares? We're going back. Home. Among the flowers. Winifred there, smiling, happy." The rockets bellowed. The warmth built up. Sweat began to run down his cheeks and was not noticed in his

exultation. Winifred, for me. Home. We're on the way."

"Space-happy," commented Santel, grim.

"Lawder, I said cut it off!"

"Back to the suns, the moons, the seas, the clouds. Back to people, millions of them. Thanks to me. The bottle is uncorked, thanks to me."

"CUT IT OFF!" Vanderveen lumbered forward, hair lank, beard dripping. The red line was three-quarters up.

"Never! Never! We're going back, I tell you. Whether you like it or not." His eyes went cunning as they saw the captain's approach. "Keep away. The rockets will run, without your orders. Keep away!" Pulling open the pilot's drawer, he made a grab inside, got something heavy and metallic blue.

A thin stab of fire came from Vanderveen's hip.

Lawder posed by the drawer, one hand propped on it. He gazed at Vanderveen, his face wet, his eyes softening. The rockets thumped and thundered. He went slowly to his knees, pulling the drawer out and spilling its contents. Leaping behind him, Santel stopped the flow to the main propulsors.

In the deep silence that followed, Lawder said apologetically, "I only want home . . . Winifred. You understand?" His voice was like a child's. He shook his head blindly, keeled over, ceased to breathe.

"Last trip." Santel stood over him, looking down. "It was his last

trip."

Vanderveen mopped his forehead. "I intended to make a near miss and frighten him. It was a bad shot."

"It was fate."

"A bad shot," persisted Vanderveen. "I had little time to think." He turned away sadly. "The pain was his, but the punishment was mine. I have slaughtered part of myself."

Santel watched him go out, slow-footed.

No man is an island.

Five weeks. Eight-forty Earth-hours. Twenty intergalactic time-units. Eons in a berillisteel bottle. And still the impenetrable dark outside, thick, cloying, the dark that has never known light or life.

Santel mooched into the navigation room, flopped into a seat. He was thin, pale, had the gauntness of one cooped up with trouble too long.

"The food is all right. Enough for a year. What's the use of it without a year's oxygen?"

Busily writing at his desk, Vanderveen did not reply.

"If we had been fitted up with half an acre of oxygen-producing Sirian cactii, like the big boats carry, we'd have been O.K. in that respect. Tending them would give us something to do. We could concentrate our worrying upon the water."

Scribble, scribble continued Vanderveen.

"Reckon the water will last us

about three weeks unless we reduce our takings still further."

No response.

"After that—curtains!" He mooned irritably at the captain's broad back. "Well, aren't you interested?"

Vanderveen sighed, put down his pen, swiveled round in his seat. "We share and share alike—to the end."

"That's understood," agreed Santel.

"It is not understood." The other's eyes were keen, penetrating as they looked into his. "You have tried to deceive me. For the last ten days you have taken less than your share. I know, for I have checked up on it." He paused, added, "So I have taken similarly less. That makes us quits."

Flushing, Santel said, "There was no need for you to do that."

"Why not?"

"You are twice my size. You need more."

"More life?" He waited for the reply that did not come. "I am older than you. I have had more life."

Santel changed the subject with the alacrity of the out-argued. "Writing, writing, always writing. Is it necessary?"

"I am entering the log, in full detail."

"It won't be read for a million years—if ever. We have departed the mortal coil. We're dead but not quite ready to lie down—though it won't be long now! That makes log-filling a waste of effort, doesn't it?"

"It is my duty."

"Duty!" sniffed Santel. "Did Lawder think of duty?"

"In a way." The captain mused a moment. "He had an all-absorbing ambition, natural, harmless, involving a woman and an Earthbound home. He had worked hard for it over many years, been denied it over many years, at last found it almost within reach. In the crisis he did his duty to his dreams, but because his dream was not ours we thought him a little crazy." He gestured to the log. "So I have written that he died in the line of duty. It is all that I can do for him."

"And it's a waste of effort," maintained Santel.

"For five weeks you have been trying various combinations on the hyperdrive. Isn't that equally a waste of effort?"

"One must do something or go nuts. Besides, it is better to live in hope than die in despair."

"Precisely!" Vanderveen twisted back to his desk, resumed writing, his pen going *scratch-scratch*. "So I accept to the very last my responsibilities as ship commander. And remote though the chance may be, a full and complete account of what occurred may be useful to somebody some day. If it served to save the skin of only one ignorant savage it would not be in vain."

Log-filling. It may be useful some day, somewhere, somehow. The dull grind of routine when life has dribbled away to a mere three weeks, perhaps less. The multi-million to one hope of providing salvation for

some barbarian a thousand generations unborn. An impossible long-shot aimed to help one ship, one sailor at a far-distant time when hyperdrives might be hopelessly antiquated and all the multitudinous existences accurately measured, weighed, estimated.

"The least one can do," added Vanderveen, by way of afterthought, "is one's duty to the last—as one deems it."

Santel stood up, staring over his shoulder, seeing the rim of beard that jutted from the stubborn chin. *Scratch-scratch* went the pen. It was like the scratchings of man-hordes at the foundations of Creation. Striving and scratching to bare the treasures and secrets hidden therein; dying and scratching and never giving up.

And it was like the scratching of his dry tongue upon his dry palate. Water. Three weeks. Twice three are six. Three threes are nine. Mistress Mary, quite contrary, how does your garden grow? Water, it needs water. Three weeks. Twice three are six.

"So I have taken similarly less. That makes us quits."

Quietly, Santel went out, closing the door. His gait was stiff, robot-like, his features set. His eyes were on something faraway and insignificant. His dream, his own dream. A scrap of paper. An unimportant roll of vellum bearing the great trans-cosmic seal above his own name. Engineer First Class. Perhaps the name

would have been written with a scratchy pen. All this for that. His dream. How futile.

A little later a thin whistle of air sounded from the front. It rose and fell, sobbing without loudness, in imitation of one who weeps muffled and alone.

Vanderveen heard the last wail of it, dropped his pen. Puzzled, apprehensive, he went to the door, pulled it open.

"Santel!"

Silence.

"Are you there?"

An awful hush.

"SANTEL!"

He raced to the bow, steel-shod boots clattering, his beard jutting forward, his eyes anxious.

There it was, the forward air lock. Fastened on the inside, open on the outside, open to the eternal dark. He looked around, big hands clasp-ing and unclasping. Three space-suits hanging nearby, bulgy but slack, like iron men drained of their insides. A note stuck to the middle one.

"I have nobody. You have many. Good-by."

Taking it down, he carried it back to the navigation room, sat a long, long time fingering the note and gazing blankly at the wall. Finally, he picked up his pen.

Another six and a half weeks. Twenty-six intergalactic time units.

Vanderveen wrote slowly, laboriously, with screwed-up eyes and many pauses for breath. He was not

engaged upon the log. That official tome lay to one side, discarded, finished with the day's entry. In that respect, duty was done, to the last. But he was still writing.

The calendar hung upon the wall, its various sector indicators all an Earth-month out of date. The chronometer had stopped. A dozen oxygen inlets were wide open and empty, not a whiff of life coming through their tubes from the depleted tanks at back. The utter blackness of nonexistence still lay over the ports, ready for invasion and further conquest when the ship's dimming lights at last flickered and went out.

Laboriously he put down, "I am not alone while I can see your face within my mind. I am not alone while I have memories of you. I thank you, dearest, for these things you have given me, because of which I am not alone." He paused to assert his will over his failing hand. "But now I must finish with fondest love to you and the children, from their affectionate father Conrad V—"

He struggled hard to complete the name, and failed.

The dark came in.

The multitudinous years, the long-rolling eons cannot be measured in death. There is no time beyond the pale of living things.

So there was no sense of bygone centuries or millennia when Vanderveen awoke. There was only intensely brilliant light and much

pain and many glistening things in which colored fluids trembled and bubbled. Also, there were voices within his mind.

"We can do no more. It's now or never. Cut out that switch and let's see if he keeps going."

Pain was all over, along every nerve and artery, in every muscle, but gradually subsiding. The soundless voices were becoming strong.

Something nearby gave a loud click. A torturing throb within him ceased. Only the slight pulsation of his heart could be felt. He was weak, befuddled and curiously tired.

"VANDERVEEN!"

It struck commandingly into the depths of his brain, forcing him to open his eyes, thrust away his lassitude.

He was lying flat on a surface soft, warm and resilient. Three men stood by his side. He knew instinctively that they were men though not like any he had ever known. None had possessed such great optics or exuded such mental power.

"You can hear?"

A whisper. "Yes."

"Beyond the Rim nothing changes, nothing deteriorates. That has saved you."

"Saved?" He strove to comprehend.

"You have been resuscitated."

Questions formed haltingly in his mind. Where am I? Who are these? How did I get here?

They must have been able to read his thoughts, for they responded, "There can be no deliberate escape

from non-space. But Creation expands into it at tremendous rate. Eventually its limits reached your vessel—and life reclaimed its own."

That was far too much for him to absorb at such a moment. He made no attempt to grapple with the concept, but listened as they went on.

"So ships come back now and again, centuries apart, like relics from the dawn of history. Yours proved to be a treasure of value beyond compute, for it contained essential data which will enable us to prevent further disappearances. There will be no more lost vessels, no more, no more."

It did not gratify him. There were other fears that prevented him from linking up yesterday's duty with today's reward.

"My wife," he got out in an agony of apprehension.

They shook sad heads, went silent.

He tried to sit up. "My children."

One patted his hand, smiled at him. "We are your children."

Of course, they must be. He sank back, closed his eyes. My children. He who serves mankind is part of mankind—and mankind's children are his very own.

A watcher turned a huge scanner, swung it nearer, showed the waiting and hopeful world that the man from seventeen thousand years ago lived once again.

And as it focused upon him, Captain Vanderveen slept knowing that he was not alone.

THE END .

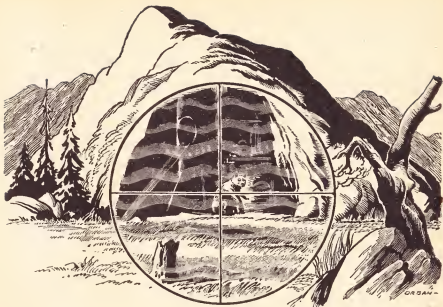
THE ANALYTICAL LABORATORY

For a while it looked as if "Feedback" and "The End of the Line" would tie for second place, but on the final scoring here's how the stories rated:

JULY ISSUE

Place	Story	Author	Points
1.	The Greatest Invention	Jack Williamson	2.77
2.	Feedback	Katherine MacLean	3.03
3.	The End of the Line	James H. Schmitz	3.08
4.	Windfall	Catherine C. de Camp	3.34
5.	For Those Who Follow After	Dean McLaughlin	3.68

The Editor.



THE HEAD HUNTERS

BY RALPH WILLIAMS

Specimen collecting is a dangerous business, and not infrequently a thoroughly sporting proposition—dangerous for both parties. Which must be accepted as the luck of the trade.

Illustrated by Orban

The man crouched shuddering in the sparse shelter of the spruce clump, flattening himself into the ground, holding moveless, guarding even the terrified thoughts which flitted through his mind. He was

gaunt and unshaven, and the knife-sharp mountain wind whipped through the tattered remnants of his clothing. He drew it closer about him—not for warmth, it was past providing warmth—but so the

ragged flutter would not betray him.

In the dry wash below, the thing that hunted him rustled and muttered to itself. Once it seemed to come his way, and he froze even stiller, striving to quiet the beating of his heart, desperately blanking his mind. It passed and moved on up the valley, and he relaxed slightly; still fearful, but with hope beginning to grow. Half an hour passed, and the thing did not return, and he stretched and burrowed in the moss, making himself comfortable, but still he did not move from his hiding place. For the rest of the afternoon he remained in the shelter of the spruce clump, not moving, not even thinking, simply waiting.

When it was well dark he ventured out, stealthily and fearfully, although he knew the thing he feared moved only in the light. He ran silently from cover to cover, stopping and listening often with open mouth. Gradually, as he put distance between himself and danger, the urgency of his terror faded. Yet still he kept moving. It was dark, the wind was cold, he had not eaten his fill for days; and he stumbled often, tearing his hands and bruising his body; still he kept doggedly on, working out of the mountains, down toward the foothills.

Somewhere down there was the railroad and people like himself and safety. The thought of this drove him along, but actually it was farther than he thought, and he was not approaching it directly, he was bearing off at an angle which would

have led him down onto the river flats. If he had not seen the fire, he would certainly have died somewhere in the hills or boggy flats.

When he first saw the fire winking and flaring on the far side of a little mountain lake, his none-too-clear mind did not recognize it, and he might have wandered past. Then as he came opposite he suddenly knew it for what it was, a campfire—he could even make out vague figures moving about it, human figures, and he shouted several times. There was no answer. With weary, dogged determination he began to work his way around the lower end of the lake, wading through boggy spots up to his waist, tripping over stunted, rooty willow clumps, crawling through alder brakes woven like basketry by wind and the weight of winter's snows. It was slow, heart-breaking work—

Neely had been hunting sheep, and he had not been finding them. Or rather, though he had seen sheep, he had seen none with the head he wanted, a head which would put his name well up in the record book. Consequently, he was not in a charitable mood.

He was a short, choleric, self-assured man, carrying forty pounds of suet on a frame which had once been muscular; and he had a short, bristly pepper-and-salt mustache and light-blue, unfriendly eyes. He was accustomed to command, to pay well for service and receive it. In this case, he did not think he was

getting what he had paid for, and he made no attempt to conceal his displeasure.

Perhaps he was right. Halvarsen had not shown him the sheep he wanted, and it is a guide's business to satisfy his sport's wants within reason—and this was not an unreasonable want. A man does not pay good money for a trip to Alaska, hire airplanes and outfits and the best sheep hunter in the country, spend perhaps one or two thousand dollars, because he has a taste for wild mutton.

He does things like this for heads, and in the four days they had been here Halvarsen had not shown him the right head, or anything near it. Halvarsen himself did not understand it. Only the month before he had flown over this area with the Game Commission man, making a pre-season check, and there had been plenty of sheep, good heads among them. Something had run them out, and it was beginning to worry him, in two more days the float-plane would return to pick them up, and if a man as important as Neely went back to the States without his sheep, it could be very bad business. Big-game hunting does not depend on mass advertising, its clientele is too restricted and specialized, a man's reputation is made or broken by word-of-mouth endorsement or disparaging rumor among the sports in the big cities Outside.

So now Halvarsen moved morosely about the evening camp

chores, and Neely sat grumpily back under the lean-to tent, half-reclining against his rolled-back sleeping bag, and sucked at his pipe.

Suddenly Halvarsen froze and turned slowly in a listening attitude to look out over the lake.

Neely listened too, but his city-dulled ears heard nothing.

"What is it?" he asked irritably. "You hear something?"

Halvarsen shrugged. "Someth'ing hollered," he said. "Sounded funny." He moved out a little toward the water's edge.

The fire was crackling and snapping, and the ripples stirred by the breeze lapped against an old stump in the lake, but the next time Neely heard it too—a faint yodeling yell.

"Loon," he snorted contemptuously.

"Might be," Halvarsen said doubtfully. "Sounded funny, though." He listened a few moments longer and then went back to his pots and pans. He thought Neely might be right, but did not believe it. A man long alone in the woods gets away from logical thinking, he grows to depend on feeling and knowledge which comes without conscious thought. He hears a stick crack back in the woods, and he does not think: That might be a moose. Instead, his memory ties instantaneously back to the seen but unnoticed dung half a mile away, the almost invisible hoof prints on a gravel bar, the clipped willow-tips the corner of his eye telegraphed in and stored

as he looked at something else; and he *knows* that *is* a moose, a picture of a bull sneaking around through the trees to get down-wind of him comes into his mind.

The noise Halvarsen had heard brought no such picture into his mind, nor any other picture, it was simply a funny noise. Probably, in the subconscious part of his mind which stored and collated the material out of which these pictures were built, there was also filed under "Unidentifiable" certain unnoticed traces of whatever it was that had driven the sheep away, and the absence of the sheep themselves; and this little store of uncertainty may have made him doubly sensitive to further false notes.

A little later, as he was unrolling the sleeping bags and arranging Neely's pneumatic mattress, he heard a faint splash from the bottom end of the lake. He knew this was not a beaver, nor a moose, nor anything else that should have been there, but he did not mention either the noise or this knowledge to Neely.

He crawled into bed and lay quietly, following the thing's progress around the lake by the occasional splash, crash of brush, or suck of feet in marshy grass. It was moving slowly but without caution, and clumsily, and suddenly he knew what it was, it still left some loose ends, but the picture was in his mind now.

He rose on one elbow and nudged Neely.

"Somebody out there," he said. "Coming this way."

"Nuts," Neely said. "What would anybody be doing here?"

Halvarsen did not answer. The man was close now, stumbling recklessly along, and making hard going. And the picture in Halvarsen's mind began to take on detail and color, picturing someone hurt or long lost in the hills, until it resembled surprisingly the ragged man he had not yet seen.

"I better go help," he said. He pulled on his boots and picked up a flashlight. "HOY!" he shouted. "Hold up! I bring a light!"

By the time he was back with the ragged man over his shoulder, Neely had kicked up the fire. Halvarsen eased the man down on one of the sleeping bags. The stranger was conscious, but played out.

"People," he said dully over and over. "Real people. I made it, I foxed the stinking bugger, he won't get me now. People, real people. I made it. I made it."

"Shut up," Neely said. He rummaged in a pack and brought out a bottle of whisky. "Here, take a drink of this."

The stranger opened his mouth apathetically and then, as the whisky stung his throat, grasped the bottle and swallowed avidly. Tears started in his eyes and he gasped and then drank greedily again.

"Hey, cut that out." Halvarsen pulled the bottle away. "You drink too much, way you are, you be drunker than a hoot owl. You wait

a minute, I warm up some of this stew."

Neely was studying the man closely, noticing the heavy growth of beard and the tattered clothing; the red-rimmed eyes and gaunt belly.

"What happened?" he asked. "You look like you've had a tough time. Lose your outfit?"

The whisky had brightened the man. He sat up now and crouched closer to the fire. "It was the panda," he said. "I was running away from him. He thought he had me in the cage, but I got away, picked the lock and got away." The stranger giggled. "I foxed him, he killed Joe, but I got away, clear away." He glanced nervously at Halvarsen and Neely. "You fellows won't let him get me, will you? You get me out of here, I'll make it worth your while. Wilson's my name, Steve Wilson. I've got plenty of money. I can pay whatever you think it's worth."

"Panda?" Neely said irritably. "What are you talking about? There're no pandas around here."

The ragged man cringed back. "Well, not a panda exactly," he said defensively. "I called it that, it kind of looked like one. It had this cave and kept me in the cage—"

Back in the cave he had hollowed to shelter himself and the spaceship and his equipment, Snrr grumbled sourly to himself. It was a bad habit he had fallen into from being much away from others of his kind; but it seemed to relieve his feelings, especially when things were not going

well. They had gone abominably, today. He had had another of those frightening spells of disorientation, the blank periods when he froze unmoving and unseeing. He knew he was getting too old for these one-man field trips; the increasing frequency of the attacks indicated this might be his last.

Worse yet, he had lost his best specimen, a live mammal showing definite signs of intelligence which he had intended to present to the zoo at Ebrrl as the fitting climax to a lifetime of distinguished field-work for the Royal Museum. The manner of its escape argued an even higher degree of cunning than he had supposed it possessed, and this made its loss doubly annoying. The door to its cage had over six hundred possible combinations, not too many for any intelligent creature to solve; but still requiring time and fixity of purpose, together with a systematic approach. He had never seen his captive show the slightest interest in the lock; yet it must have fiddled patiently with the thing at every opportunity over a period of days or weeks, whenever he was absent or his back was turned; to learn and memorize the combination for use when opportunity offered.

And what cleverness to wait for one of his attacks, to trip the door catch and sneak quietly out during his paralysis, switch off the protective field outside the cave entrance, and scamper away! He moaned inwardly, feeling a loss like a vacuum in his belly, at the thought of this en-

gaging animal escaping him, and regretting that he had been too busy to properly evaluate and study it before.

Well, he thought resignedly, what can't be helped must be borne. He went about preparing his evening meal, moving with the pattering fussiness of a very old bachelor. Afterward, he plodded wearily up the ramp to his bed in the ship. His bones ached—he had gone far afield that day, trying to track down the runaway. Ordinarily, he worked deliberately and methodically, husbanding his strength, plotting out the ranges of the specimens he sought, feeling them out with his mind, patiently nudging them toward him with carefully disguised mental impulses, till they came within range of his anaesthetic darts. This scurrying and running after a panicky quarry was not to his taste nor best abilities, and the exertion had taken its toll.

Still, he paused for a moment in the storeroom to gloat over his loot—the carefully cleaned and preserved skins, skeletons, and heads, all neatly packed; the bundles of meticulous notes, sketches, and films; and best of all, on the wrapping bench, still unpacked, the twin to the specimen he had lost. He picked up the head and turned it gently in his tentacles, admiring again the regularity of features; the noble height and breadth of forehead, the wisp of black mustache; the lifelike plastic eyes, with their bold, bright, fierce stare.

Neely and Halvarsen had not done too well at prying information from the fugitive. After being fed, he lapsed into semicoma from which he mumbled disjointed and repetitive responses to their questions, and finally they let him sleep. At intervals during the morning they woke him and fed him and tried again, but his rambling replies continued to be irritatingly vague and senseless. Apparently a reaction to the shock of his captivity and flight had set in which made it difficult for him to speak or think coherently.

What they were able to get did not make sense, at least to Neely.

Halvarsen did not try to make sense of it.

He had listened and watched quietly most of the time, while Neely questioned, and a new picture had begun gradually to form in his mind. This picture was of a large, teddy-bearish creature, furry and black, with white markings, and two sets of short sturdy tentacles branching from its shoulders. Halvarsen had never seen a panda, but his business was big game, he had seen pictures and read of them, and he knew this was not one, though Wilson called it that. This was no common animal, it was something which thought and acted like a man, which used tools and machines, which killed for pleasure rather than food. It tortured and mutilated its prey, penning live captives in cages until their turn came.

The picture was full of holes and

blurry, the animal moved jerkily and in ways not clear, its motivation was vague and its origin vaguer; but as far as it went it fitted the absence of game and the other little subconscious observations Halvarsen had made.

He believed it.

Neely had no picture and he did not believe what he had heard, but he had come to think something had followed Wilson, perhaps a wolverine, and he was curious.

"There aren't any sheep here," he said flatly. "They've moved out, there's no use looking any more."

Halvarsen nodded gloomily. "That's right. This panda thing scare them away."

Neely eyed him sharply. "You think that's why they've left?"

"Sure," Halvarsen said. "Sheep, they're pretty particular what comes around them."

Neely shrugged. "Maybe. Anyway, we might as well see if we can find this thing, whatever it is. You think you can backtrack Wilson?"

"Sure," Halvarsen said. "Why not?"

Wilson did not take kindly to the idea of being left alone, but they gave him what was left of the bottle and reassured him they would be gone only a short time, and he grudgingly promised to remain at the camp until they returned. Even Neely could follow his back trail in most places, but the hunters moved cautiously, not knowing just where they might encounter the thing they sought, nor how wary it might be.

They came to the place where Wilson had hidden late in the afternoon, and were almost ready to turn back when Halvarsen froze and grunted, pointing with his chin, and Neely followed the direction of his eyes. Neely saw nothing at first, and then suddenly it moved and he saw it, a patch of starkly black and white fur, moving up a little slope perhaps half a mile away. It might have been anything—a skunk, a magpie, or even a man; except that skunks are not found at that altitude, and it did not move like a man or a magpie.

It had not seen nor sensed them, Neely thought, and he motioned Halvarsen down, crouching himself with a slow, almost imperceptible motion, so as to blend into the hillside, till from a little distance he would have seemed an old, gnarled stump, or perhaps a rock. He dared not use the glasses, lest their flash catch the thing's attention, and with his bare eyes he could make out no details. It was simply an indefinable mass, moving unhurriedly, purposefully along.

Snrr was feeling better today. He had started out on a halfhearted continuation of his search for the lost specimen, and sometime during the afternoon had suddenly become aware that two others of the same species were approaching him. What luck! Fresh, unaware minds, susceptible to suggestion!

He followed their progress avidly, his pleasure mounting as he became

aware they were consciously seeking him, out of curiosity stirred by knowledge of the escaped animal. He stimulated this curiosity gently, and showed himself to them at the moment they were almost ready to turn back. Now he squatted in the entrance to his cave, feeling them hidden on the ridge across, studying him in their turn. Their wariness and curiosity made them easy subjects; their high-keyed nervous systems reacting beautifully to the slightest mental touch. He let them stay there for a while, wondering how best to ambush them.

Across the narrow valley, Neely lay flat on his stomach just under the ridge, his glasses glued to his eyes. The light was fading fast now, but Snrr's cave was on the westerly slope, and he showed clearly in the glasses. His huge, benign face was turned ruminatively down the valley, and the white markings like spectacles about his eyes, the white-banded muzzle and lower jaw and belly, did make him look startlingly like a huge toy panda. Only the tentacles, coiled idly along his forelegs, were out of place.

"I can't believe it," Neely whispered. "Here, you look. See what you think."

Halvarsen took the glasses and focused them carefully.

"Yah," he said stolidly. "That's him, all right."

He shifted the glasses slightly, studying the approaches to the cave. "You see that funny yiggle in the air, like heat waves?" he asked. "I

bet that's that thing that Wilson feller said you couldn't see, but couldn't get through either, till he turned the switch off. What do you think, huh?"

Neely had not noticed. He took the glasses back. Now his attention had been called to it, he could see a faint shimmer in the air directly in front of the cave.

"It must be," he said. "It just don't make sense, but it's there." He was a matter-of-fact individual, used to seeing things proceed in orderly and methodical fashion, and what he was seeing now offended the deepest core of his logic. Still, he found himself accepting it as true. He did not realize this urge for acceptance proceeded, in part, from Snrr.

It was almost dark now, and Snrr did not function well in the dark. He caught the embryo thought in Neely's mind that it might be better to return to camp and come back in the morning for another look. This fitted well with Snrr's plans, it would give him time to prepare a proper ambush for them. He gently built the thought up into resolution in Neely's mind, and followed the two men back until mental contact faded out with distance.

Back at camp, the two men found the whisky gone, Wilson asleep, and the fire out. Neely broke out a fresh bottle while Halvarsen found wood and started the fire.

For the first time, Neely offered to share his whisky, and Halvarsen ac-



cepted gratefully, both for the improvement in relations it betokened and for its own sake.

"You know," Neely said while Halvarsen fried bacon and warmed beans, "that screen in front there, that thing you can't see, makes it kind of awkward. You think it might stop a bullet?"

Halvarsen shrugged. "Might be."

"We could try one and see," Neely said thoughtfully. "But then we might spoof him. No, we've got to either catch him outside or get him to turn it off."

"Well," Halvarsen said, "let's eat now, we can figure on it later." He

split the beans and bacon carefully between the two pans, whacked off a huge slice of bread with his knife, buttered it and passed the loaf and the butter to Neely. For a while both were too busy to talk, it had been a long time since lunch, and the whisky had sharpened their appetites.

After dinner, over their third cup of tea, they returned to the subject. It did not take them long to work out the possibilities, the object of this hunt was an unusual one, but the principles remained unchanged.

"Well, that might work," Halvarsen said finally. "But how we going

to get that Wilson feller to help? He's pretty scared of that panda thing."

"Here's the convincer, right here," Neely said with a tight grin. He held up the second bottle of whisky, still more than half full. "All that boy wants to do is drink himself to sleep so he can forget what happened. We don't have to tell him where we're going, he'll follow this bottle."

"Yah, I guess so," Halvarsen said doubtfully. Something else was troubling him, but he could not quite put his finger on it. By now his mental picture of the strange beast was almost complete, and there had been something out of character in its actions this afternoon.

"You know," he said suddenly, "that Wilson says this feller can get inside your head, make you think things aren't so. You think he might do that to us?"

Neely looked startled and thoughtful. "Well, I don't know," he said finally. "He wouldn't let us come up on him so easy, if he could do that, would he? Wouldn't he steer us away?"

"No, I don't think so," Halvarsen said slowly. "He caught Wilson and Wilson's buddy, maybe he wants to catch us, too? I think maybe we just better be pretty careful tomorrow, not do anything foolish because it looks easy."

Snrr thought they had better be careful, too. In the mid-morning he

waited confidently at the entrance to his cave, the controls to his hidden dart-throwers near at hand. Presently he picked up the feeling of the men approaching, coming warily but confidently along. At first the knowledge that Wilson was with them was disconcerting, but then as they came closer and he picked up clearer thoughts, he smiled to himself. It seemed they were bringing his captive back, perhaps as some sort of peace-offering or bribe. So much the better. He would get all three. There was room for only one live specimen, but he could keep the best alive and have two more heads besides.

At the lower end of the valley the men separated, one going along the ridge they had followed the day before, the other two coming straight up the valley toward his cave. This was fine, Snrr thought, he had prepared for either route, this way he could take them one at a time without alarming them. His former captive, he noted, was one of the two coming up the valley, and was now beginning to show signs of panic, which might not be so good, but probably would not frighten the other two seriously, since they had expected this.

The ragged man had been preoccupied before, following the big blond man without paying particular attention to his surroundings, but now he suddenly began to orient himself, and he did not like it. He hung back and remonstrated, and the big man took his arm and

pulled him along, and this frightened him more. The big man pulled him around and shoved him ahead up the valley. He screamed then, in a high piercing voice, and ran a little way, then looked wildly around and ran off to one side, apparently with the intent of ducking past. The big man lifted something to his shoulder, dirt spurted in front of the ragged man, there was a sharp crash, and he paused, then began to run blindly up the valley. The big man stopped and calmly watched him go.

Snrr began to have doubts. He had lost track of the third man, and the running man's horrible fright was blanking out what the big man was thinking, but there was an unmistakable aura of menace in the air which Snrr found confusing—something intent and calculating, quite unlike the usual brainless rage of cornered animals.

He let the running man go past the first ambush, uncertain whether to take him or not. At the second point, he decided a bird in the hand was worth two in the bush; and fired. The anaesthetic darts took immediate effect, but Wilson's fright continued to echo in his mind, crashing like static over the lower-pitched thoughts of the other two. The big man had disappeared at the moment Wilson fell, and Snrr could not immediately locate him, but still he received that heavy overtone of menace, like the faraway roar of a lion. He could not see very well either, the shimmer of the protec-

tive field directly in front of him blurred his vision. He was beginning to feel boxed-in and unsure of himself, and he decided to cut the field for a moment and get a clear view of what was happening, orient himself for action against the two remaining. He reached out to the switch which controlled the field.

After leaving Halvarsen and Wilson, Neely moved up the ridge toward a spot opposite the thing's cave. The place where they had been yesterday was too far away, a good seven hundred yards, but there was a small hogback angling down to a knob directly across from the cave. It was this he was aiming for. Halfway along the ridge, he began to feel it might be better to go up the farther ridge first and reconnoiter, but this would have disrupted their carefully laid plans, and he turned off. It did not occur to him that Snrr might wish him to go on up to the booby-trapped area they had been in the previous evening, it was just that he was single-mindedly intent on getting to his assigned position. Perhaps if Snrr's attention had not been distracted, he might have felt differently.

Neely came up the far side of the knob and eased around its base until he had a good view of both the valley and the cave. Carefully, he measured the distance with his eye. Two hundred—no, nearer two fifty. Close enough, even if three hundred yards. His sights were set at two fifty, at two hundred yards the bullet

would rise one inch. At three hundred it would drop three inches. Dead on would kill, at either range.

Experimentally, he dropped his eye and sighted, his cheek nestling comfortably against the warm walnut stock, right hand automatically bringing the butt tight against his shoulder. In the thrice magnified field of the scope the beast stood sharp and clear, faced a quarter toward him, intently studying something it held in its tentacles, apparently unaware of either Neely or the other two. The picket point rested like a finger against the forward point of its right shoulder.

But was that right? Where would the vital organs of a beast such as this be? The head, perhaps, since its eyes were in its head, and its ears, as in other animals. But suppose its brain was in its belly, as he vaguely thought he remembered some reptiles' was said to be? In the chest then? What if the heart, or what served for a heart, the lungs and blood vessels, were in the abdomen? It must be the neck, for the neck would logically carry communications between the head and body, must be one of the most vulnerable points. Low down in the neck, where the muscles of chest and shoulder would give something for the bullet to work on, give it a chance to open properly, and two hundred and twenty grains of lead and copper alloy, arriving at its destination with a force of slightly better than two tons, would take care of the rest.

The picket swung gently, seeking out the spot, finding it at different angles as the beast moved about, growing used to it.

Then, with his eye still holding the thing in the scope, he moved his right hand away and waved it gently twice. He did not look to see if Halvarsen saw the signal. That was Halvarsen's job.

Presently, he did not need to look. High and shrill across the distance, he heard a scream of fear and terror, then a shot and more cries. The beast heard it too, and stared nearsightedly down the valley toward Halvarsen and the ragged man. Neely kicked the safety with his thumb and put the first faint breath of pressure on the trigger. The beast was restive now, it picked up something and fiddled indecisively with it, then manipulated it in an obscure fashion, and the screams abruptly choked off. The beast peered across at where Neely lay, then back down at Halvarsen. It stepped uncertainly to one side, raised a tentacle to something on the wall, and suddenly the faint shimmer in the air died. In the same instant, the rifle roared. Neely had the bolt worked and the slack half taken up on the trigger in the instant before the scope swung back onto the cavern.

But there was nothing to shoot at, nothing to see, except one black and white paw which scratched jerkily at a sunlit spot on the cavern floor, and then was still. Neely watched it steadily for perhaps five minutes.

It did not move.

He met Halvarsen at the bottom of the hill and they climbed up to the cave together. Halvarsen stared around in awe at the ship, the strange implements and instruments, but Neely had eyes only for Snrr.

He smoothed the soft, woolly fur, noting what a beautiful pelt the thing had, and turned the head so the light struck it. Already he could

see it mounted on a pedestal, holding something, perhaps a smaller animal, in its curious tentacles, peering nearsightedly off into the middle distance, exactly as it had appeared in his scope.

And underneath, the plaque: "Contributed by S. W. Neely, from his Alaskan hunt; *ursus*—no, new species; *Neeliana* (better yet) *Martianus*—? *Venusian*—? or simply *extraterrestrialis*?"

THE END

IN TIMES TO COME

One of the factors about this prediction of Times to Come that should be made somewhat clearer is that there is quite a time-lapse between the time I first see a manuscript, and the time it appears in the magazine. The schedule on publication might be of interest to you.

Not being a news magazine, not basing our interest on the latest item, still quivering from the wires, we can save considerable money for more useful things like higher author rates and paper, by taking a leisurely schedule. Our pages get printed when it's convenient to schedule press time between the high-pressure, high-speed priority rush jobs. Our typesetting helps smooth out the load between rush jobs. Our schedule is somewhat more leisurely.

The cover on the November issue is by Chesley Bonestell, illustrating R. S. Richardson's article "Making Worlds Collide," and is, in consequence a special case. But let's consider this October issue. The cover story, "Iceworld," should have been on hand, for the artist's use, by May 7, 1951. It was actually purchased May 23rd; we were late on that one, although I started working on the novel with Hal Clement in April. At the end of May, van Dongen got the manuscript, and started the painting, and black and whites. The other stories in this issue all had to be sent to artists for black and white illustration May 28th, and returned here, with illustrations, June 11th. Stories were due to leave for typesetting, edited and proofread, by June 25th. Make-up of the final magazine is in mid-July—and the short items such as this, and The Analytical Lab, are prepared at that time. Brass Tacks is sent through about two weeks earlier.

So at this moment, I have the covers for the November and December issues on hand, and the January cover is in the artist's hands. Result: when someone says "The story in your present issue. . . ." I sometimes present a slightly blank appearance. What is the present issue? July, August, September, October, November——? My calendar runs with continuously slipping gears!

THE EDITOR.



THE REFERENCE LIBRARY

BY P. SCHUYLER MILLER

NO SCIENCE IN SCIENCE FICTION?

The annual book issue of *Science*, weekly journal of the American Association for the Advancement of Science—April 20, 1951—contains a thoughtful article by J. R. Pierce of Berkeley Heights, New Jersey, entitled "Science and Literature," which is in effect a very searching critique of present-day science fiction. The complete article is must reading for every science-fiction writer and serious reader.

Mr. Pierce is no hostile carper against "trash." He is a friendly critic who knows science fiction, en-

joys it, and wants others—especially scientists—to enjoy it. "Science fiction," he writes, "has brought a new dimension of escape, and an unfettered mind to explore it." Prejudices and taboos, he finds, lose some of their sanctity in this medium, but science itself has gone with them.

"What bothers me is that so few of the stories have any scientific ideas in them," Mr. Pierce continues, "and, in fact, not many have ideas other than those of the most obvious sort: the atom bomb is dangerous, empires must fall and dark ages come, dictators will be destroyed. Of course, there are exceptions, but even some of the best stories, by the

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best writers suffer from maladies of the times."

One of these maladies the writer traces to the policy which has become identified with this magazine. He credits its editor with rescuing science fiction from the juvenility of the early 1930's, but suggests that the well-known Campbell policy of turning to the effects of gadgets on human beings and human society "has served as an excuse for a progressive deterioration of the hard scientific and technological core in much of science fiction.

"Many present stories," Mr. Pierce says, "are built, not around science and technology, but around a bag of standard magic tricks. Time travel—a convenient hyperspace to outwit relativity and to enable one to travel faster than light—robots and thinking machines that have arbitrary limitations or no limitations, are standard but overworked ingredients . . . In quick-paced writing on such a scale, the distinctive features of persons and cultures are lost. There is no time to describe strange societies, strange beings, or strange individuals, and all become standardized, a part of the bag of magic tricks. Personally, I'd rather have pure fantasy and go with L. Sprague de Camp and Fletcher Pratt into worlds of magic . . . because there's something to see and something to think about."

This is a pretty damning criticism, and it is not one that can be answered by pointing to exceptions—which Mr. Pierce himself cites liber-

ally. Is it true that, as a trend, there is less and less science in modern science fiction, and more and more of what the writer calls "magic tricks"?

To a degree—perhaps a considerable degree—it is true. The most obvious reason is that as the field of science fiction has grown up, its readers have grown with it. Rather than tricks, the conventions of which Mr. Pierce speaks are stereotypes. Sprague de Camp has pointed to more of them in his article here last July, "The Care and Feeding of Mad Scientists." It is no longer necessary to explain, in every story dealing with space, that stars will be pinpoints of light; it is no longer necessary to describe the physical features of the moon, or Mars; it is no longer necessary to parrot Wells' dimensional analogy to explain the concept of time travel; it is no longer necessary to point out that the limitations of relativity must be somehow by-passed to travel faster than light. These things have been repeated over and over so often that to the initiated reader they are as familiar as fingerprinting to the detective-story fan. And neither Mr. Pierce nor any other reader wants to be told in each story that fingerprints are unique, that central files of them are kept, and all the rest.

What has happened, then—and what should happen? At one time the trend was to physical gadgets, "thought variants," new twists to the familiar relationships among

time, space, and matter. Now, it seems, we are equally gadget-ridden—but with social gadgets, new twists to the relationships among people and their environment which we call culture or society. And this process of extrapolation and exploration should, and often does, make us think. Certainly the outcome of Jack Williamson's "... And searching Mind"—"The Humanoids"—was nothing pat or obviously acceptable.

But what of the physical sciences? The answer—the standard which would please Mr. Pierce, and perhaps make him more willing to recommend science fiction to the readers of *Science*—lies in what Robert Heinlein has done so well, especially in his series of juvenile novels for Scribner. The science is there—item by item it can be plucked out, identified, and justified—but it is integrated in the background and structure of the story. More is implied about conditions in space through the training routine of "Space Cadet" than through most old-fashioned explicit descriptions of a trip to the moon. "Farmers in the Sky" presupposes an entire technology rooted in our own, but reaching beyond it to the stars. Less elaborately, the same sort of thing is done in John Campbell's own "The Moon is Hell." Stories like these are the targets at which we should aim—certainly not a reversion to the spelled-out minutiae of Jules Verne and the school he started.

Stories about people? That standard can be met also. In 1950 the best

example of its accomplishment was Judith Merrill's "Shadow on the Hearth." So far this year it has been William F. Temple's "Four-Sided Triangle." These books were novels about real people dealing with situations which have become science-fiction stereotypes. As Mr. Pierce points out, Sinclair Lewis' "Arrow-smith" was such a book about the professional life of a scientist—a physician—through whom we looked a little way into the kind of life he represented.

There is danger in writing for a clique that the clique will become a clique, applauding what is familiar, turning a cold shoulder on whatever is different. Astounding SCIENCE FICTION has consistently stood out against such petrification, and if writers will meet Mr. Pierce's challenges squarely, we can look forward to seeing science restored to science fiction in the sense and to a degree which he should find commendable.

FURY, by Henry Kuttner. Grosset & Dunlap, New York. 1950. 186 pp. \$1.00

The short serial of life in the undersea Keeps of Venus, which appeared here four years ago under the *nom de plume* "Lawrence O'Donnell," is now the first original novel in the excellent Grosset & Dunlap "Science-Fiction Classics." It would be a good story at three times the price—which it would have cost from any other publisher.

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Readers of Astounding SCIENCE FICTION will recall "Fury" as the second in an excellent series which Kuttner-O'Donnell for some reason then cut short. Its very human hero, Sam Reed, is a mutilated offshoot of the Immortal aristocracy which rules the subsea Keeps with a viciously iron hand. Believing himself an ordinary short-lived human being, he launches a revolt against the Harkers—his own kin—and for a new assault on the hostile land masses of Venus. His first coup fails, but out of it comes the knowledge of his own immortality and the "long view" which the Immortals claim as their excuse for ruling. Then, in a final drastic move, Sam tears mankind free of the soft security of the Keeps and launches the race on a new drive toward the stars.

Action, intricate plotting, and the Kuttner color are all here. But why stop?

FOUR-SIDED TRIANGLE, by William F. Temple. Frederick Fell, Inc., New York. 1951. 240 pp. \$2.75

If we exclude the annual "Best" compilations by Everett Bleiler and T. E. Dikty, "Four-Sided Triangle" stands out as the best volume yet to appear in Fell's Science-Fiction Library and a strong contender for the best science fiction novel of 1951.

Its very nearly unique quality in

this crowded field lies in the warmly believable characters whom William Temple has created to carry out what—the jacket blurb to the contrary—is by no means "a new and original plot." Bill Leggett and Rob Heath are an oddly assorted pair of young scientists, tied together by their affection for the narrator, the village G.P., Dr. Harvey, and presently by their relationship with the odd young woman, Lena Maitland. They have invented a matter-duplicator, and when it is evident that Lena will marry Rob, the only way to break the strain in their friendship seems to be to create a duplicate Lena. But the new girl, Dorothy, *is* Lena in every atom of body and personality—and so the four-sided triangle is forged. Because the four people entangled in its distorted geometry are not cardboard puppets but very human beings, there can be no pat solution—nor does the author force one.

As with Judith Merrill's "Shadow on the Hearth" last year, this is the kind of book which should win discriminating readers from other fields to science fiction.

THE UNDESIRE PRINCESS, by L. Sprague de Camp. Fantasy Publishing Co., Inc., Los Angeles. 1951. 248 pp. \$3.00

If the title story, taken from *Unknown Worlds* of 1942, had been

another de Camp-Pratt collaboration, the hero would undoubtedly have been Harold Shea instead of Rollin Hobart, consulting engineer. Hobart's adventures in a world of strictly Aristotelian logic, always purely yes-or-no, black-or-white, and embarrassingly literal, have the utterly reasonable brand of unreasonableness which most readers know and relish. Having rescued a princess by smashing paradoxes with an androsphinx, made friends with a talkative "social lion" straight out of Oz, blundered into chieftainship of assorted barbarians on top of his traditional claim to the princess and half the kingdom of Logaia, and dueled with a reasonably potent wizard, he is relentlessly maneuvered into the toughest spot of all as god of this exasperating world.

For a bonus there is the short "Mr. Arson"—*Unknown*, 1941—in which the author draws on his own experience as a correspondence school executive to imagine what happens when such a school sells an incomplete course in Necromancy, the conjuration, control, and exorcism of elemental spirits, and a customer cooks up a fire-spirit without knowing how to get rid of it.

If you like humor-in-fantasy, who can afford to miss a new de Camp?

—

DRAGON'S ISLAND, by Jack Williamson. Simon and Schuster, New York. 1951. 246 pp. \$2.50

In this new novel, not previously serialized, Jack Williamson plays another change on his favorite theme of a coming race. In "Darker Than You Think" he gave us *Homo lycanthropus*, in "The Humanoids" a man-made super-race, and now in this new story of our own times we meet the "not-men," the successors to mankind who have elsewhere been dubbed *Homo superior*.

Dane Belfast, young geneticist, finds himself drawn into a fantastic tangle of plot and counterplot in which he is never quite sure who is doing what, or what side he is on or wants to be on. He is searching for his father's lost friend, Charles Kendrick. He is approached by a detective, John Gellian, for help in what purports to be a struggle for survival between men and not-men. He meets little Nicholas Venn and the strange vegetable "mule" he has brought from the heart of the dragon island of New Guinea, where the mysterious financial wizard, J. D. Messenger, operates the plantations of Cadmus, Inc. And there is the beautiful Nan Sanderson who finds him somehow wanting—and who may herself be a mutant or the agent of mutants.

Is Potter, Messenger's genetic genius who can control life by reshaping genes, the missing Kendrick? Is he alive or dead? Is he, as Gellian insists, sowing dragon's teeth across the face of the earth in the shape of rebuilt supermen, waiting for their chance to eradicate

their parent race? Belfast finds an answer to these questions and to the true nature of *Homo excellens*, deep in the mountains of Dragon's Island.

SEEDS OF LIFE, by John Taine. Fantasy Press, Reading, Pa. 1951. 255 pp. \$2.75

In the unbelievably short period of six years, from "The Purple Sapphire" in 1924 to "The Iron Star" in 1930, John Taine—otherwise Professor Eric Temple Bell of California Institute of Technology—drove himself to a unique position in the science fiction world with a succession of still-memorable science mysteries. He followed them in 1934 with a fictional reconstruction of the age of the dinosaurs, "Before the Dawn," published by a scientific house, then turned to the popularization of mathematics. It was not until 1946 that a new series of Taine novels, culled from the magazines, began to appear.

"Seeds of Life" appeared first in 1931, just after his greatest book, "The Iron Star." It is one of the two or three top-notch Taine novels not yet published in book form—dated in a very few respects—we now know that cosmic rays are particles rather than ultra-short radiation—but full of the outrageously daring flights of the imagination which are the Taine trademark.

As in most of his books, the theme is biological—the sources of life, and of the forces which mold life. An accident remakes the blundering technician, Neils Bork, into the mutant superman, Miguel De Soto, and at the same time sets in motion other processes which attract the attention of Bork's employer, Andrew Crane, and the very competent Dr. Brown. By blatantly concealing clues from the reader, as is his habit, the author keeps several mysteries at the boiling point—what has happened to Bork, to the black widow spider, to Bertha the hen; what is "De Soto's" plot against the mankind he considers degraded and degrading; what, above all, is the theory of evolution and devolution around which the whole book is built?

In some ways this is almost a companion-piece to "The Iron Star." If the superman, De Soto, never emerges in three dimensions as did the unfortunate apeman, the Captain, in the latter book, he is none the less no stereotype. And there is plenty of the biting satire on man's nature and culture which we can also expect of a Taine book. We should not have had to wait twenty years to see it between covers.

THE WEAPON SHOPS OF ISHER, by A. E. van Vogt. Greenberg, New York. 1951. 231 pp. \$2.75

In "The Weapon Makers"—Astounding SCIENCE FICTION, 1943; Hadley Publishing Co., 1947—A. E. van Vogt introduced us to the Weapon Shops, to the immortal Robert Hedrock, and to the beautiful Empress Innelda of Isher. That story began in the year 4790 Isher, seven-thousand-odd years in our own future. The new book deals with events which occurred six years earlier, and with another crisis in the centuries-long feud between the Isher rulers and the Weapon Makers.

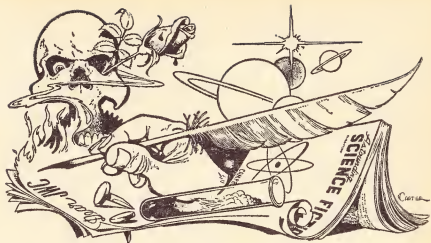
The crisis of this book is the temporal seesaw created through Innelda's efforts to destroy the Weapon Shops. A man of 1951 is swung with ever-increasing amplitude into the past and future, counterbalancing the shorter swings of the Empress' great destructive machine. While the mad teeter-totter is going on, the Weapon Makers have a respite—but its stopping may mean

the utter destruction of the universe. Played out against this background is the story of Cayle Clark, used by the Weapon Shops for their own ends and trying desperately to keep control of his own fortunes. He does so with typically van Vogtian twists. It will take agile wits to know just what is happening, or why, at any given time. And behind it all you have the development of the Weapon Shop concept—that an interplanetary empire can be governed only by something approaching dictatorship, and that this must be balanced by an equally centralized counter-force feeling itself justified in taking any measures necessary to bring about the ultimate good of mankind. This concept of a permanent underground seems more and more prevalent in modern science fiction. But whether or not you argue with the ideology of the book, those who read it first here will want it in their libraries.

THE END

ENGLISH SPELLING BOOK. Lesson One.

Hough oughen oughsetting it is tough nough tough much. Key words:
Bough. Cough. Hiccough. Through. Though.



BRASS TACKS

Dear Mr. Campbell:

The end of patience has come. I had to write. PLEASE CONTINUE THE SERIALS!

Even though in the last few months there has been a flock of critics of the serial hounding the pages of ASF, I did not expect the announcement that the serials would not be continued for a time.

In '48 and '49 your magazine was well-balanced with short stories, novelettes, and something like four serials a year. Now you propose to feed the readers a diet of the shorts and novelettes. It won't work. Most yarns need a rounding out of the theme for the sake of a good story. Shall they be discarded because of

their length? NO!

Serials admittedly have the drawback of that long waiting period between parts but I think that its good points, especially the fact that stories about human characters are harder to write and better reading than stories in which the plot revolves around an idea or a machine, outweigh this drawback.

Now my ratings from the June issue:

1. . . . And Then There Were None: Russell can always be relied on to give a good story.
2. The Mauki Chant: The interesting rhythm of the verse held the yarn up.
3. Breeds There a Man: Not quite

up to Asimov's usual standard. It was not long enough to develop the idea to a more enjoyable conclusion.

4. Crisis

5. Bait

Four and five are standard for ASF.

I enjoyed the article immensely. Don't drop those or I'll surely drop dead.—Lawrence Stafford, 318 S. 11th Avenue, Alpena, Michigan

*The majority agreed on serials.
"Iceworld" begins in this issue.*

Dear Mr. Campbell:

Though my percentage of the bills on ASF amounts to only twenty-five cents a month I have to get my quarter's worth of comment in—or keep my mouth shut if you begin to run serials again. Please—let's not have them. People who want their pleasure in reading split must have masochist tendencies. Editorially I suppose there are those who will buy the next issue in order to get the last half of a story, but for me, F—I.W.! Remember Poe? "If any literary work is too long to read at one sitting we must be content to dispense with the immensely important effect derivable from unity of impression, for if two sittings be required, the affairs of the world interfere and everything like totality is at once destroyed."

Cover on June issue excellent. It is intriguing and interest provoking

with the spaceship, bicycle and faces of men of character. A perfect example of the caliber of covers I'd like to see on all science-fiction magazines. I do get tired of the unconsciously snooty people looking down vari-shaped noses at SF. They just don't know what it is and blatantly unclothed girls are no help in breaking down public antipathy. I don't believe the class of readers who go for unclad girls are potential SF fans—or am I being snooty?

Now for story rating—not that I'm overly fond of commenting on each story, I'm not. You, as editor, liked them all or you wouldn't have used them. But here goes:

. . . And Then There Were None: Nice twist on carrying to the ultimate in freedom the return to barter. Apt to be a bit more unwieldy than the invention of legal tender has made things. Could be a 15th of March inspiration?

Bait: Inverted news story. Reporting.

Breeds There A Man: Isaac Asimov does an excellent job of characterization which is all too rare in SF and gives a good plot besides. This story alone makes June issue a big bargain. Asimov is always dependable for a workmanlike, excellent job. Better than lead novelette is my vote.

Crisis: The basic idea here is good but suffers in the handling. Change of viewpoint bothers. Criticism is MUCH easier than production!

Two-edged Miracle: Didn't read. I disliked Chemistry in high school.

Hated it in college, which is indicative of the fact that I was no shining light in Chem class (required). In science-fiction field I belong to the faction that is more interested in a good story based on science but not too technical. I'll settle for H_2O rather than H_2SO_4 .

The Mauki Chant: Plaintive, wistful, human. Don't think I would go for many epic poems with interpolated interpretation and reactions but this one is good.

As a whole, naturally I like *Astounding* SCIENCE FICTION or I wouldn't continue to buy it or put forth the effort of writing to say please no serials and the bonus effort of rating stories. SF and fantasy fills a need that I've found in no other field of fiction—when one finds a really good story it rates more than passing pleasure—the ideas there stay when author, story and publication have slipped the mind completely. And ideas are worth wading through a great deal to get. —Alice Bullock, Santa Fe, New Mexico.

Poe to the contrary not withstanding—there are stories that can't be told in one sitting. Good stories. What of these, then?

Dear Mr. Campbell:

As you know, among the science-fiction writers who concern themselves with such things it is generally

accepted that interstellar travel by means of hyperspatial shortcuts is possible because distances are a lot less that way. Now on closer inspection this sounds like circular reasoning—which it is—but I have never yet read in any story an explanation of the theory behind hyperspatial interstellar travel which did not, in the final analysis, boil down to the one that I have just mentioned. Some writers, I must admit, explain that our space is so kinky that it is possible to travel between points light-years apart thereby going only nominal distances in hyperspace; but even so, they do not explain the character of the kinks.

Being highly in favor of hyperspatial interstellar travel but greatly distressed by the present sad state of its theory, and having had a term of mathematical analysis, last summer I tried to see what I could do about the situation. The eventual result was a hypothesis which provides not only a logical basis for hyperspatial interstellar travel, but also an explanation for a hitherto inexplicable characteristic of all observed parapsychological phenomena—the fact that the intensity of the effect is completely independent of the physical distance separating the phenomenon from its cause.

For several months after the hypothesis first occurred to me, other matters prevented me from doing anything about it except giving it a few scraps of thought at odd times. But later I got around to devoting a little pencil-and-paper work to it,

and in less time than it takes to write this letter I devised what seems to be a very sound mathematical proof for my hypothesis. Intuitively the proof is not very appealing because of the apparent lack of accord between its conclusions and ordinary observation; but mathematically it is based on only the strictest logic. Here it is:

We are given a straight line of infinite length. Since it happens that such an expression as "infinite length" has no real mathematical meaning unless we state exactly what is meant by it in a given situation, let us describe the line in different words. Let us say that the line is of length L , where L is an infinite number. As it stands this is still unsatisfactory, since we have not yet defined "infinite number," but fortunately analysis gives us an excellent definition.

Let us take any number ϵ greater than zero. We can make ϵ as small as we please, just so long as we do not make it zero or negative. It fol-

lows that we can make $\frac{L}{\epsilon}$ as large as

we please, merely by taking ϵ small enough. Let us say, then, that for

every such ϵ , L is greater than $\frac{L}{\epsilon}$.

Analytically, this makes L an infinite number.

Next let us divide L into n parts, each of length s . Provided that s is finite, n will obviously be an infinite number like L , and in fact

L

equal to $\frac{L}{s}$. Instead of actually sepa-

rating the parts into which we have divided L , however, let us simply fold the line back on itself at the end of each section. Since there is no incontrovertible reason why such a process would have the slightest effect on any one-dimensional creatures that may inhabit the line, we can say that as far as its inhabitants are concerned, the line still seems straight and continuous throughout the whole of its infinite length.

Nevertheless, mathematical lines having no dimensions other than length, the bundle of line segments that results from our folding process will be no thicker than the original line, and thus will look to anyone outside it exactly like a single line segment of length s . But lest it be objected that although a bundle containing any *finite* number of line segments piled on top of another takes up no more space than a single line segment, it is conceivable that a bundle containing an *infinite* number might show some thickness, let me hasten to add that I have investigated this side issue very carefully.

Let us assume, for the sake of argument, that we can choose an n so large and an ϵ so small that $n \cdot \epsilon > \epsilon$. If this is the case, then by dividing both sides of the equation by n , we

obtain $\epsilon > \frac{\epsilon}{n}$. But since ϵ must be

positive, and a zero or negative

n would be ridiculous, can only be

n
greater than zero. It follows that the statement $n.0 > \epsilon$ is an absurdity, and $n.0 < \epsilon$. Since we have chosen ϵ as small as we could, $n.0$ will never get large enough to bother us.

What I have been doing with infinite and infinitesimal numbers would seem to many people to be not quite cricket. They might say to me, "There's only one infinite number, and that's infinity. Any finite number divided by infinity gives a quotient of zero, and hence there aren't any infinitesimals distinct from zero. These facts prove conclusively that all the stuff that you've been saying is nothing but nonsense.

To this I reply, "Look at infinity and zero a little closer. I'm sure you'll find that both come in many sizes, some of which are as many times greater than others as 'infinity' is greater than finite numbers, and as the latter are greater than 'zero.'" There my defense rests. The supporters of a single infinity and a single zero do not have to believe me, of course, but they cannot deny the truth of this statement: nobody ever discovered the true nature of things by observing no more than just enough to support what other people were saying!

Let us return to the main part of the proof of my hypothesis, of which little remains. Our next step

L
is to let $n > -$. Since $L = ns$, then
 ϵ

ns
 $n > -$, or $s < \epsilon$. This leads directly
 ϵ

to the statement of my hypothesis: Given a straight line of length L ,

I
where $L > -$ for every $\epsilon > 0$, dividing
 ϵ

the line into an infinite number of sections of equal length, and folding the line back on itself at the end of each section, it is possible, by taking

L
the number of sections $n > -$, to
 ϵ

make the length of each section $s < \epsilon$, thereby reducing the line, without observable effect on any inhabitants it may contain, to what is for all practical purposes a *point*.

How this provides a logical basis for hyperspatial interstellar travel and an explanation for the fact that the intensity of parapsychological phenomena is completely independent of the distance between the cause and the effect is not immediately obvious. Yet the principal corollaries of the theorem make the value of the hypothesis quite clear: (1) Given a space of n dimensions, it is possible, by successively reducing each space to a space of one fewer dimensions, to reduce the original space to the practical equivalent of a point. (2) It is entirely possible that our own four- or five-dimensional space-time continuum is actually contained in a "volume" less than ϵ^4 , and hence can behave like a point.

Of course this "point" is not a

true point, since it does have a little length, a little width, a little height, a little of the fourth dimension, et cetera. But all its dimensions are less than any given positive number, and thus as far as we are concerned, this "point" is really a point. It is obvious that we cannot be completely certain that our physical universe is actually a near-point composed of "crinkled space-time," but if it is impossible for anything to travel any distance in ordinary space without passage of time and diminution of intensity, thought can, and does, do it by going no distance in hyperspace from one crinkle to another. And if thought can do it, why not interstellar spaceships?—William R. Rennagel, Eden, New York.

Shall we say he has a point there?

Dear Mr. Campbell: —

Since nonrestricted "small" reactors have been the subject for discussion in ASF lately, it might be of interest that I mention a uranium-heavy water reactor practically completed at Kjeller, Norway. It will form the core of the newly created Norwegian Institute for Atomic Energy and is to be used for experimental purposes and isotope production by a joint commission of

Norwegian and Dutch scientists.

Its power level will be one hundred kilowatt, and fissionable material—approximately three tons—will be uranium and uranium oxide; most of which was obtained by Holland prior to World War II. Moderator will be seven tons of heavy water from Norsk Hydro; graphite will serve as a neutron reflector and water and concrete make up the radiation shield. The heavy water is cooled in a heat-exchanger.

Key men of the project have been Gunnar Randers and Odd Dahl, and most of the electronic equipment was built at the Chr. Michelsen Institute in Bergen. It is interesting to note that Norway is the first of the "small countries" that have taken such an important and difficult step as constructing a reactor, and it has been done with practically no aid from the larger nations. Still this reactor will be far superior to the French one at Fort de Chatillon, and also very much superior to the planned Swedish reactor.

In other words, let's give Norway a cheer for being "on the ball."—Per F. Dahl, San Francisco, California.

And despite the fact that Norway suffered heavily during the war!

(Continued from Page 62)

had never heard those words, either; but they were different enough from the usual human conversation to start him shivering. The thought of strained or severed relations with Planet Three was one he could not face—and this being was definitely excited and more than probably angry. That blow on the hull of the torpedo—

Drai's tentacle whipped past Sallman Ken at the thought, and the main power and drive director switches closed as one. The investigator swiveled around on the control rack, and eyed his employer curiously.

"You seem almost as excited as the native. What's the matter?"

Laj drew a deep breath, and finally got his voice under control. He was just beginning to realize that his dramatic entry had not been the wisest of moves. It was perfectly possible that his hired expert had learned the name of Earth's product quite innocently; and if that were the case he would be ill-advised to attach too much weight to the incident—publicly, at least. He shifted ground, therefore, as smoothly as he could.

"Your chemical analysis seems to have encountered complications."

"It would seem so. Apparently your natives are not quite so completely diurnal as you gave me to understand." Ken was not intentionally defending his actions, but he could have found no better answer.

Laj Draï paused momentarily.

"Yes, that is a point that surprises me a little. For twenty years they have never signaled except during their daytime. I wonder if the flatlanders had anything to do with it? I can't imagine what or how, though. Did you finish your tests?"

"Enough, I guess. We'll have to bring the torpedo back here, so I can find out just what that atmosphere did to my samples. Some of them burned, we already know, but I'd like to know what was produced."

"Of course it couldn't be sulfides. That's what one thinks of as the natural product of combustion."

"Not unless frozen sulfur dust is suspended in the atmosphere in tremendous quantities. I hadn't thought of that, though—I'll check for it when the samples come back. Actually, I'm a little bothered by the results so far. I couldn't think of anything gaseous at that temperature which would support combustion, and something definitely does."

"How about fluorine?" Laj was digging in the dim memories of an elementary science course.

"Maybe—but how come it exists free in the atmosphere? I should think it would be *too* active, even at that temperature. Of course, I suppose the same would be true of anything which would support combustion, so we'll simply have to wait until the samples are back. You know, I'm almost at the point where I'd be willing to risk a landing there, to

see what the place is like."

Drai shrugged expressively. "If you and Feth can figure out a way of doing it, I won't stop you. We might even see our way to offering a bonus. Well, it'll be nearly three days before your stuff is back here, and there won't be much to do in the meantime. Feth will cut it in on the beam when it's far enough from Three."

Ken took this as a hint to leave, and drifted aimlessly out into the corridors. He had some thinking of his own to do. As Draï had said, nothing could be done about Planet Three until the return of the torpedo, and he had no excuse for not considering Rade's problem for a while.

The product was called "to-facco." That, at least, was information. Rade had had no name for the narcotic he sought, so the information was of questionable value so far.

This planetary system was relatively close to Sarr. Another fact. The precautions taken by Draï and his people to conceal that fact might or might not be considered reasonable for a near-legal commercial enterprise, but were certainly natural for anything as blatantly criminal as drug-running.

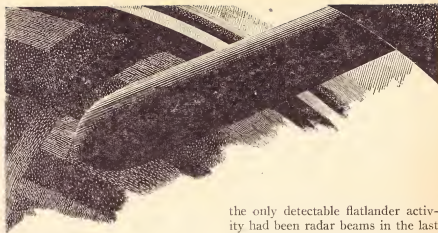
Planet Three was cold—to put it feebly—and the drug in question could not stand normal temperatures. That was a link of rather uncertain strength, reinforced slightly by Draï's tacit admission that "to-

facco" was a vegetable product.

Think as he would, he could recall no other information which could be of the slightest use to Rade. Ken was mildly annoyed at the narcotics chief anyway for involving him in such a matter, and was certainly more willing than a professional policeman would have been to go back to the purely astronomical and ecological problem that was facing him.

How about his pesky Planet Three? Certainly it was inhabited—a fantastic enough fact in itself. Certainly it was not well known; no vision transmitter and no manned ship had ever got through its atmosphere. That seemed a little queer, now that Ken considered the matter again. Granted the fearful cold, and the fact that an atmosphere would conduct heat away as space could not, he still found it hard to believe that a competent engineer could not design apparatus capable of the descent. Feth was supposed to be a mechanic rather than an engineer, of course; but still it seemed very much as though the organization were singularly lacking in scientific resource. The very fact that Ken himself had been hired made that fact even more evident.

Perhaps he was not so far from Rade's problem after all. Certainly any regular interstellar trading organization could and always did have its own ecological staff—no such concern could last without one, considering the rather weird situations apt to arise when, for ex-



ample, metal-rich Sarr traded with the amphibious chemistry wizards of Rehagh. Yet he, Sallman Ken, a general science dabbler, was all that Laj Draï could get! It was not strange; it was unbelievable. He wondered how Draï had made the fact seem reasonable even for a moment.

Well, if he found out nothing they would probably not bother him. He could and would investigate Planet Three as completely as he could, go home, and turn his information over to Rade—let the narcotics man do what he wanted with it. Earth was more interesting.

How to land on the blasted planet? He could see keeping large ships out of its atmosphere, after the trouble with the natives of the flat, bluish areas. Still, torpedoes had been running the gauntlet without loss for twenty years, and

the only detectable flatlander activity had been radar beams in the last two or three. Those were easily fooled by quarter-wave coatings, as Draï had said. No, the only real objections were the frightful natural conditions of the world.

Well, a standard suit of engineer's armor would let a Sarrian work in a lake of molten aluminum for quite a while. There, of course, the temperature difference was less than it



would be on the Planet of Ice; but the conductivity of the metal must be greater than that of the planet's atmosphere, and might make up the difference. Even if it did not, the armor could be given extra heating coils or insulation or both. Why had this never been tried? He would have to ask Feth or Laj Draï.

Then, granting for the moment that a landing could not be made even this way, why was television impossible? Ken refused to believe that the thin glass of a television tube could not be cooled down sufficiently to match the world's conditions without shattering, even if the electrical parts had to be kept hot. Surely the difference could be no greater than in the ancient incandescent bulbs!

He would have to put both these points up to Feth. He was heading purposefully back toward the shop with this plan in mind, when he encountered Draï, who greeted him as though there had been no suspicious thoughts in his own brain that day.

"Feth has cut you in to the main beam, and no piloting will be needed for nearly three days," he said. "You looked as though you were going back to your controls."

"I wanted to talk to Feth again. I've been thinking over the matter of armor and apparatus withstanding Planet Three's conditions, and it seems to me something could be done." He went on to give a censored version of his recent thoughts to his employer.

"I don't know," the latter said when he had finished. "You'll have to talk to Feth, as you planned. We've tried it, since he joined us, and the failures occurred just as he said in the matter of television. He was not with us on the original expedition, which did no investigating except as I originally told you—it was strictly a pleasure cruise, and the only reason there were so many torpedoes available was that the owner of the ship preferred to do his sightseeing in comfort—he'd send out a dozen at once, when we entered a planetary system and keep the *Karella* in space until he found something he wanted to see or do personally."

"I've never met him, have I?"

"No—he died long ago. He was pretty old when we hit this place. I inherited the ship and got into this trading business."

"When did Feth join you?"

"A year or two after I got started—he's the oldest in the crew in point of service. He can tell you all about the engineering troubles, you see, and I certainly can't. You'd better see him, if he feels like talking."

Without explaining this last remark, Draï disappeared down the corridor. Ken did not wonder at the words—he had already come to regard Feth as a taciturn personality.

The mechanic did not appear to be busy. He was still draped in the rack in front of the torpedo controls, and seemed to be thinking. He rose as Ken entered the room, but said

nothing, merely giving the equivalent of a nod of greeting. Not noticing anything unusual in his manner, Ken began immediately to spill forth his ideas. He was allowed to finish without interruption.

"Your points all sound good," the mechanic admitted when he had heard them, "and I certainly can't bring any theory against them. I can merely point out that the tubes do break. If you want to send down a suit of armor full of thermometers and pressure gauges, that's all right with me, but I trust you'll pardon a pessimistic attitude. I used up a lot of good TV equipment in that atmosphere."

"Well, I admit your superior practical knowledge," replied Ken, "but I do think it's worth trying."

"If the instruments read all right, who goes down in the armor the next time? The thought makes my knee-joints stiff. I'm scared of the idea, and don't mind admitting it."

"So am I." Ken remembered the uncontrollable emotion that had swept his being the first time he had seen Planet Three. "It's a ghastly place, beyond doubt; but I still like to find things out, and I'm willing to take a chance on my health to do it."

"Health . . . huh! You'd be a ready-made memorial statue five seconds after the first pinhole appeared in your suit," retorted the mechanic. "I almost feel it's a dirty trick to send good instruments down into that, even when I know they can take it. Well, I'll break out

a suit of armor, if you really want to try it. There are plenty of torpedoes."

"How can you carry it by torpedo? You can't possibly get it inside, surely."

"No; there are rings on the outer hull, and we can clamp the suit to those. We'll just have to be careful and go through the atmosphere more slowly, this time."

He glided down the length of the shop to a set of lockers at the far end, and from one of these wrestled a suit of the much-discussed armor into view.

Even under Mercurian gravity it was difficult to handle. Owing to the peculiarities of the Sarrian physique, a greatly superior leverage could be obtained from inside the garment; but even knowing this, Ken began to wonder just what he was going to do if he succeeded in reaching the surface of the massive Planet Three in that metal monstrosity, under nearly four times his present gravity. That thought led to a question.

"Feth, what sort of body chemistry do you suppose these natives have? They move around—presumably—under a whopping gravity in a temperature that should freeze any organic material. Ever thought about it?" The mechanic was silent for some time, as though considering his reply.

"Yes," he said at last, "I'll admit I've thought about it. I'm not sure I want to talk about it, though."

"Why not? The place can't be

that repulsive."

"It's not that. You remember what Draï said he'd do if anyone gave you information about the stuff we got from the planet?"

"Yes, vaguely; but what does that have to do with it?"

"Maybe nothing, maybe not. He was pretty sore about my telling you the name of the stuff. I wouldn't have done it if I'd stopped to think. The situation just seemed to call for a quick answer, so I gave it."

"But your ideas on the native chemistry could hardly tell—or I suppose perhaps they could. Still, Draï knows perfectly well I've never worked for another trading company and I'm not a trader myself—why should I be treated like a commercial spy? I don't care particularly what your stuff is—I'm interested in the planet."

"I don't doubt it. Just the same, if I ever make any more slips like that, please keep whatever you learn to yourself. I thought there'd be a nuclear explosion when Draï walked in with you yelling 'To-facco!' into the mike."

"He couldn't really do much, though." This was a ranging question; Ken had started to think again.

"Well—" Feth was cautious about his answer, "he's the boss, and this isn't such a bad job. Just do the favor, if you don't mind." He turned back to the armor, with an expression on his face which indicated he was through talking for the time being. Ken found himself unable to

get anything definite from the mechanic's answer.

He didn't think about it very hard anyway, for the other problem proved too interesting. Feth was certainly a good mechanic; as good as some rated engineers Ken had known. He had opened the armor completely and removed all the service plates, and started the job by giving it a full overhaul inspection. That completed, he refilled the zinc circulating system and replaced and safetied the plates he had removed, but left the armor itself open. One eye rolled questioningly at the watcher, and he spoke for the first time in two hours.

"Have you any ideas about instrument arrangement? You know best what you want to find out."

"Well, all we really need to know is whether the suit can maintain temperature and pressure. I suppose a single pressure gauge anywhere inside, and thermometers at the extremities, would tell enough. Can you use telemetering instruments, or will we have to wait until this torpedo gets back, too?"

"I'm afraid we'll have to wait. The instruments themselves would be easy enough to install, but the voice transmitter in the armor couldn't handle their messages. I can put a multiple recorder in the body, connect the instruments to that, and arrange so you can turn it on and off by remote control—I'll simply tie it in to one of the suit controls. I suppose you'll want to be

able to manipulate the suit heaters, as well?"

"Yes. If it takes anywhere near full power to maintain livable temperature, we ought to know it. I suppose extra heaters could be installed, if necessary?"

"I expect so." For the first time, Feth wore an expression approximating a grin. "I could probably mount blast furnaces on the feet. I'm not so sure you could walk around with them."

"Even if I can't I can at least see."

"If you don't have the same trouble with your visor that I did with TV tubes. Even quartz has its limitations."

"I still think it can take it. Anyway, it won't cost *us* anything to find out. Let's go ahead and mount those instruments—I'm rather curious to see which of us is right. Is this recorder all right?" He took from a cabinet a minute machine whose most prominent feature was the double reel of sensitized tape, and held it up as he spoke. Feth glanced at it.

"Only one record. Get an L-7. You can recognize it by the reel—its tape is about five times as wide. I'm using the single barometer you suggested, and thermometers in head, trunk, one foot, and one sleeve as far out as I can mount it. That leaves a free band on the tape that you can use for anything you want." The mechanic was working as he spoke, clamping tiny instruments from a well-stocked supply cabinet into the places he had men-

tioned.

For a moment Ken wondered whether the existence of this more than adequate instrument stock did not invalidate his argument about the lack of scientific facilities; then he recognized that all the devices were perfectly standard engineering instruments, and represented nothing but a sizable financial outlay.

In spite of Feth's evident skill, the job was a long one. They did not sleep, being Sarrians, but even they had to rest occasionally. It was during one of these rests that Ken happened to notice the time.

"Say," he remarked to his companion. "It must be daylight on that part of the planet by now. I wonder if Draï has made his landing yet?"

"Very probably," Feth replied, one eye following Ken's gaze toward the clock. "He is more than likely to be back in space again—he doesn't waste much time as a rule."

"In that case, would I be likely to be skinned for dropping in to the observatory?"

"I probably would be if Draï found out I'd encouraged you," was the answer. "I think it would be better if you stayed here. There's plenty for us to do."

The work turned out to be timed rather nicely. By the time the armor had survived a one-hour leakage and radiation-loss test in the vacuum of the shadowed air lock, had been clamped to the load rings of another torpedo, and launched

into the void on automatic control, the other projectile was on the point of landing. The automatic control, in fact, was necessary—the second missile could not be handled by radio until the first had been docked, since the other controlling station was still being used by Drai to bring his own load back.

A single rest period fitted nicely between the launching of the suit and the landing of the mobile laboratory; and Ken was awaiting the latter with eagerness when it finally drifted through the air lock under Feth's expert control. He would have pounced on it at once, but was restrained by a warning cry from the mechanic.

"Hold on! It's not as cold as it was out on Planet Three, but you'll still freeze to it. Look!" A tentacle waved toward the gleaming hull, on which drops of liquid sulfur were condensing, running together and trickling to the floor, where they promptly boiled away again. "Let that stop, first."

Ken stopped obediently, feeling the icy draft pour about his feet, and backed slowly away.

Long minutes passed before the metal was warmed through and the drip of liquid sulfur ceased. Only then did Feth open the cargo door, whereupon the process was repeated. This time the straw-colored liquid made a pool on the floor of the cargo compartment, flooding around the crucibles and making Ken wonder seriously about the purity of his samples. He turned on

all the heaters at low strength to get rid of the stuff as fast as possible. Since there was a serious chance of further reaction with the air if a high temperature were attained, he opened the switches again the moment the hissing and bubbling of boiling air ceased; and at last he was free to examine his results.

Some of the little pots were full; most of these appeared to be unchanged. Others, however, were not.

A white powder was literally over everything, as Roger had already seen. The yellow flecks of sodium peroxide were turning grayish as they decomposed in the heat. The gold crucible had been pulled from its base, but was otherwise unchanged; the iron had turned black; sodium, magnesium and titanium had disappeared, though the residue in each crucible gave promise that some of the scattered dust could be identified. There was still carbon in the container devoted to that substance, but much less of it than there had been.

All these held Ken's attention for only a moment, however. Two facts alone really reached his brain. Just inside the cargo door, clearly imprinted in the dust, was a mark utterly unlike anything he had ever seen; and lying a little distance from this—for Roger's wrist watch had drifted from the spot where it had been dropped, during the torpedo's flight—was an object whose implications almost made Ken dizzy.

(To Be Continued)

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(Continued from Page 9.)

reaction. The environment is mechanical, wholly mechanical, and solely mechanical. It can, therefore, be approached only on the strictly mechanical level.

The human body is a biomechanical structure. It has magnificent biomechanical engineering. A committee of engineers studying the human body can find in its structures highly developed examples of practically every engineering art. The architect and strain-distribution specialist can study the human skull, and see incredibly ingenious interlocking arch structures. The acoustic engineer finds, in the ear, a marvelous mechanism for impedance matching, to transfer sound energy from the thin medium of air to the denser medium of liquid—and magnificent devices whereby that highly efficient mechanism can be made less efficient at will, in order to adjust for over-intense sound waves.

But that is mechanical.

Psychologists have long known that human beings *do* record sound phonographically, sight photographically, and all sense-impressions similarly. That was original with Hubbard in a degree, but it was not a new discovery. These abilities are purely mechanical; all memory is purely mechanical. A phonograph has no intelligence, but remembers sounds. Punched-cards have no intelligence, but can remember a man's description, his name and address, his business, his

fingerprints, and a thousand other details, if desired.

These memory functions are mechanical.

Association of ideas can even be made mechanical, too. Punched-card machines, fed data on a man's fingerprints, can associate that data mechanically with the data of who, where, and what.

Until the actual extent of *mechanical* functions in Man is recognized, the true field of the typically human function, as distinct from the mechanical, remains unallocated, and therefore no effectively directed efforts at reaching and understanding it can be made.

In his enthusiasm for the mechanical side, Hubbard pushed the mechanical explanation too far; in their enthusiasm for human individuality, psychology and philosophy have tended to push the line too far the other way.

The *thinking* process is mechanical, purely mechanical, and is not in any way part of the personality. It is purely the reaction of the physical structure to the physical environment.

Now the characteristic of mechanisms is their ability to tell what when, how much, et cetera. They do just fine at that. When a machine comes along, however, that refuses to do so, and instead of reporting the neutron flux concentration at the heart of an atomic pile, or the Bissell's Functions required, but instead types out on its output register

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"Why should I tell you?" something new has been added.

Hubbard's dianetics recognizes that before any understanding of the mind is possible, some calibration of the physical universe with respect to the mind is essential. It is a technique of studying the past experiences and learning what, when, where, who, how, and how much. So long as it goes that far and no further, it can, and will, help the physical ills of the physical mechanism.

Only when it extends into the field of pure philosophy and asks "Why?" does it become a true mental science attacking the true human problems.

Psychoanalysis failed because it didn't determine with adequate detail *what* happened, and did not understand what factors were important. Dianetics supplies the technique necessary to gather that data. But philosophy, not psychoanalysis or psychiatry, supplies the techniques for handling that data after it has been garnered.

Part of the essential problem has been missed because of the cultural climate that originated about 1800. Up to that time, physical sciences had been making little progress indeed, because teleological, anthropomorphic thinking dominated "science." In the terms of that time, the heat generated in burning oxygen and hydrogen was the heat of the passionate embrace of the hydrogen atom for the oxygen atom, and the ardor of their love was equal

to sixty-eight thousand calories per mole. Solving the problems of physical science in those terms conspicuously failed to work—wherefore teleological thinking and anthropomorphism were given the yo-heave-ho and progress commenced. Things happened because there were physical laws, not because there were motives. Even today traces of the old motive-type, teleological thought remain in the language of science. In gravitation, we speak of bodies *attracting* each other, and certain chemicals have an *affinity* for water.

Unfortunately, the success of the nonmotivation, nonhuman thinking in physical science, and the rejection of introspection as a proper technique for understanding the world, spread to fields where it did *not* belong. Anthropomorphic thinking does *not* apply to hydrogen atoms—but it does apply to *anthropos*, to Man himself. Introspection will *not*, for all the studying of the inward whichness of the why, explain the Balmer series in the hydrogen spectrum. But cyclotrons and spectroscopes have notably failed in explaining why a paranoid believes every man's hand is against him. To paraphrase the comment of a true thinker, render unto introspection, the things that are introspective, and unto spectroscopes the things that belong therein. Confusing things in either direction leads to spectacularly wrong answers.

Atomic energy yielded to the searching probe of the cyclotron; international insanity will not yield

to that—it can only be annihilated by it. Because foam rubber proves utterly futile in driving nails does not prove that foam rubber is useless.

Dianetics, as Hubbard presented it, was incomplete. The errors in it, the holes in it, were promptly, loudly, and emotionally pointed out by those who were making equal errors in the opposite direction. A relatively small percentage of psychologists, psychiatrists, doctors, and philosophers did, however, get in to the field and study the work. The reports of these men are not yet available; it takes more than a single year to evaluate such material. It can properly be taken as an indication of extremely inadequate evaluation if a man can report that "This is useless!" or "This is the ultimate and complete answer!" in any six-months study. No adequate evaluation can be completed in less than five years. Certainly no one-week study of a subject as fundamental as the theory of the nature of the human mind can be considered meaningful.

Those who have studied dianetics during the last year have only preliminary reports; summed up, they uniformly say "There's something extremely important here!" Those who condemn dianetics utterly because it is incomplete condemn their own thinking; Newton's observational rules for motion and gravity were incomplete. There have been attacks on dianetics be-

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cause Hubbard was not a professional psychologist; Newton was not educated as a physicist, Priestly was not a chemist, and Pasteur was not an M.D. In a truly highly evolved science, where there are many definitively explored fields of knowledge, years of professional experience *are* needed. But in a field which is still only quasi-scientific, where doctrine and authority and theory rather than law-of-nature rules, that is not the case. The test of whether a science exists is fairly simple; can an experienced practitioner of the field specify accurate tests, to determine quantitative factors, select material on the basis of those tests, and predict with ninety per cent or better minimum accuracy the response of that material to specifically prescribed conditions? If he can, there is a science; if no man can guarantee such performance, there is no science, but only an art.

Some branches of medicine, under that rule, would be science; some are arts. The entire field of the mind, however, is clearly, at this stage in human history, definitely an art.

Dianetics, as Hubbard presented it, was incomplete; what was needed, however, was study, evaluation, and further work to complete it. It was essential, however, that it be presented for study, and that was done by this magazine.

Some thousands of people have, in the succeeding year, studied it, worked with it, and are developing it. It is far from complete; its mechanical aspects have, inevitably, at-

tracted many people who are mechanically — mechanistically — inclined, and relatively few who were philosophically, nonmechanistically inclined. That is, actually, an inevitable tendency, and an unfortunate handicap, since it tends to lead to further development of the already fairly well developed mechanical side, rather than the largely undeveloped philosophical aspects. Also, it is far easier for a human mind to face the question "What happened to me?" in the mechanical sense, than to face and solve the problem "What am I?" That one, as many a philosopher has found, is exceedingly disturbing and uncomfortable. But that latter question is, of course, the one that must be answered.

That dianetics produces some remarkable results is readily demonstrated. Individuals dying of psychosomatic conditions have been brought back to good health.* A

* Limited clinical records to this effect are already available; their value is, so far, indicative rather than definitive because of the inescapable factor of time. Hubbard's own records are of relatively little value, because the necessary elaborate before-and-after medical, psychometric and psychiatric records were not prepared. The professional-level research in the field began only *after* June, 1950; indicative results were obtained in the first year, but these records are not acceptable as definitive until the results then obtained have been shown to persist over a period of years.

In consequence, while rather spectacular relief of acute conditions—suicidal mania, psychosomatic ulcerative colitis, peptic ulcers, et cetera—have been obtained, time, and only time, can prove in the worth of the method. The medical profession does not permit formal publication of clinical records on any such new technique until years of testing stand behind it. Thus formal clinical records cannot be expected before 1955; here we are dealing with human beings, not with a physical science, and the problem is vastly different. In physical science, an experiment is repeatable—the ingredients of the experiment can be specified with accuracy, and the specifications matched. In human science, this is not, and never will be the case. Even "identical" twins are *not* identical.

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man suffering from severe gastric ulcers, scheduled for operation in two weeks, canceled the surgery after one week, and celebrated the cancellation with a steak, French-fries, and beer dinner. A relief, after several months on strained baby foods. The ulcers were gone. A young woman with arthritis of the shoulder lost all symptoms; X-ray plates before, during, and after conclusively showed that calcification existed before, was in process of dissolving ten days after starting processing, and was gone thirty days after processing began. Another young woman at a State hospital for the insane was scheduled for prefrontal lobotomy as a hopelessly, permanently and violently suicidal case, after forty-nine electric shock treatments. After three months of processing, she had a secretarial job, and was, according to her relatives, more stable than she had ever been. The suicidal mania, incidentally, broke after half an hour of processing; addi-

tional processing was necessary, of course, before the acute neurosis was ended.

Acute compulsive neuroses have been broken in hours; it does not mean that *all* cases will respond spectacularly and swiftly, but that it happens at all means that there is *something* new at work. Specifically, Hubbard's. observational rule that neurosis of the acute level is direct and literal carrying out of a specific verbal command seems demonstrated. One man had developed a compulsive neurosis to the extent that his driving was approaching homicidal tendencies. When driving, if he saw a friend driving toward him, he had a strong compulsion to drive right into the approaching car. So far, he had succeeded in negating against it, and drawing up, shaken mentally, for twenty minutes or so before he could proceed. This neurosis disappeared after finding the statement-command of his Mother saying "I

always like to run into my friends on the street." This case, incidentally, was handled by one of the co-operating psychiatrists, and has shown no recurrence of the neurosis.

Another decidedly undesirable driving pattern showed up in a man who, after attending his father's funeral in a town some fifty miles from his home, spent hours driving in circles, and arrived home finally in a state of physical and nervous collapse. His compulsive neurosis had forced him to turn right at every intersection he came to. It was only by a violent effort of will that he had been able to refrain sufficiently to get home at all. His father had been a minister; the command-statement in this neurosis appeared to have been: "You must always take the right road, son." Relieving that particular situation, in any case, ended the neurosis. There seems adequate evidence that Hubbard's thesis that *direct and literal interpretations of statements* plays an exceedingly important part in human neurosis.

Repression of normal caution was the result of a different type of command. State Highway Safety directors should be interested; the individual in this case had been in half a dozen extremely severe smash-ups, usually at speeds between sixty and eighty miles an hour, and had survived by a series of minor miracles. He had led an adventurous life, with a number of narrow escapes. There was a considerable and violent fear reaction when the command-

statement "Don't worry, nothing's going to kill you!" was finally found and run out. The fear-reaction came from re-evaluation of the various automobile crashes.

Life can be interesting, but usually short, when such a command-statement is in operation.

Dianetics itself, the mechanical approach to the human mechanism, is definitely valid. It's exact extent, and its exact possibilities remain to be explored. And the immensely greater field of philosophy that must be evaluated beyond dianetics, is still almost unexplored. Individuals who have cleared up the physical problems, and then proceeded into the philosophical problems, have already made many basic discoveries that seem extremely important.

For example, psychology and philosophy have long struggled with the problem of what emotion actually is. Philosophical introspection seems the only possible means of studying that question—and at the present time there seems to be excellent indication that an answer has been found. Emotion seems to be of only two true types; pure emotional pleasure, and emotional misery, unhappiness. These, however, are simply the pain-pleasure drives applied to the individual when he departs from basic, genetic behavior patterns. Man is gregarious by inheritance; departure from that pattern would be a defiance of the genetic behavior pattern—and would be



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rewarded with unhappiness.

Evolution studies have largely been devoted to the investigation of comparative anatomy—the physiological side of evolution. But cows are herbivorous not simply because they have herbivore teeth; a cow can digest meat with high efficiency. The physiology is accompanied by a genetically determined behavior pattern. The evolution of behavior patterns is extremely difficult to study—but it is certainly exceedingly important. That behavior patterns are genetically determined is obvious—but the significance of those behavior patterns in human beings has not been adequately studied. If a genetic pattern exists, it is useless unless there is some means whereby it can enforce itself on the organism. It's been popular, for lo, these many years, to talk about "mechanisms" and explain everything in those terms. It works extremely well for atoms and molecules, and even simple things like

radar sets. It works very poorly with human beings, or even animals. Living creatures are more complex; they have motives, desires, wishes—something beyond mere mechanism. And emotion is simply the enforcing agency of the genetic patterns, apparently.

There has, incidentally, been a great deal of philosophical condemnation of "Man's animal instincts"; the next time some one brings up that old saw, I suggest you ask him to name the animals—other than Man, of course—that torture their own kind for amusement as a public spectacle, indulge in homosexuality, or abandon their new-born young because they are inconvenient. And which animal showed the more typically animal pattern, the Spartan parent who exposed his child on a hillside, or the wolf that took the little corpse home to feed her cubs?

It might be pointed out that genetic behavior patterns are evolved,

just as physiological patterns are, and that a pattern of life that has undergone 2,000,000,000 years of field testing, or 300,000,000 years, as the mammalian patterns have, are not apt to be particularly given to destructive tendencies.

The other old saw about "self-preservation" being the first law of nature can stand some healthy, critical inspection, also. A recent headline read: "Stewardess Saves Ten, Dies Trying To Save Others." Does such a headline make you feel, "The darned fool. What the blazes did she do a stupid thing like that for—risking her neck for somebody she never saw before!" or was your reaction that *that* was what made being a human being worth while—that *that* was something-worth while? Now if self-preservation is the first law, why, naturally, you'd feel embarrassed at the stupidity of anyone like that stewardess, or Roger Young who knowingly gave his life for his friends, or the silliness of a man who loses his life saving a child he didn't know.

On the other hand, if genetic behavior patterns are major factors in our lives and thinking—then one would expect a different pattern of response. Genetic behavior patterns would have to *evolve*; they would be *species* patterns, and would exist only if the species existed—would survive only if the species survived. That would have a tendency to make species survival patterns have a greater chance of continuation than individual-survival patterns. The

tiger is a lone wanderer; tigers don't team up. But human beings do; evidently we have a different species survival pattern. And evidently part of it is that the group is to survive, even if individuals have to give their lives for it. That family-group must die for tribal-group, and tribal-group must die if thus only can the race, the species, be protected.

Patterns that live through millions of years, millions of generations—aren't apt to be destructive. And violation of such a time-tried pattern of life should carry a penalty.

There are great possibilities of understanding oneself, and that work has only begun. Dianetics, by handling only the physical aspects of the problem, cannot assure happiness—but it can act as the key to the greater problem.

The dianetic aspects, the physical-mechanical aspects, can be handled by a commercial, professional man, for money. But the deep self-understanding that must be achieved for full happiness can be achieved only with the help of someone who is strongly, warmly, personally-emotionally attached to the individual. That deeper self-understanding will, and must, be a home therapy, both because of the need of that personal attachment, and because it takes many, many hours of thinking to rework an entire life philosophy. Hubbard was *much* too optimistic on that.

The goal to be achieved, however,

is something beyond anything hitherto sought. Psychoanalysis seeks "adjustment"; philosophy seeks full understanding. The *fully* cleared individual—a state not yet achieved by anyone—is one who has full conscious awareness of *all* the sources of *all* of his motivations. The first step, however, is the *dianetic* clear—one who has found all the command-statements which have been serving as *false* motivations.

Incidentally, the goal of psychoanalysis—"adjustment"—is anything but desirable. It is, actually, seeking to achieve a state of apathy, a state of accepting the slings and arrows of outrageous fortune, and, by not taking arms against the sea of troubles, to end caring about them. "You must face reality and accept your environment, adjust yourself to it" is a negation of precisely the characteristics that make man Man. Man, alone of animals, does *not* accept his environment, and will *not* face reality. The reality, at this moment, is that the night is cold, and wet, and the wind is blowing, and my skin is thin and furless. But I have refused to face reality; I have taken reality by the ears and made *it* face *me*. I have a steam-heated, electrically-lighted house, and warm, dry clothes. The animals adjust themselves to reality; man adjusts reality to himself. George Washington may have been neurotic in psychoanalytical terms—he didn't face reality, either. He insisted on changing it to meet his ideas. The ideal state achieved by the doctrine of ac-

cepting reality is a nice, even apathy; face the fact that your skin is thin and hairless, and the night is wet and cold, and don't be unhappy. Just accept it.

The man who first lands on the Moon is going to be someone who, as a kid, wouldn't accept that when he reached for the glowing Moon, it was too far away to reach. Some man who's so "neurotic" he figures it's better to try, even if it kills you, than to give up and quit. Some fellow who thinks "impossible" means "we haven't figured the darned thing out yet," who feels that "reality" means "the raw material from which we intend to build what we want."

I don't believe anyone ever found a neurotic clam, however; they're beautifully adjusted to their reality.

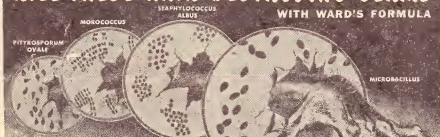
Actually, what Man needs is to understand reality-as-it-is in the greatest possible detail, figure out what potentialities the situation-as-it-is has, decide what he wants, then go to work on that reality and make what he can of it.

Dianetics is a technique of facing reality—the physical facts of which reality is, actually, made, and a technique for distinguishing between the raw material and the vastly greater power, man's mind, and thereby permitting a thorough examination of each, separately, to prepare the way for a proper program of interaction.

It needs a tremendous amount of development.

THE EDITOR.

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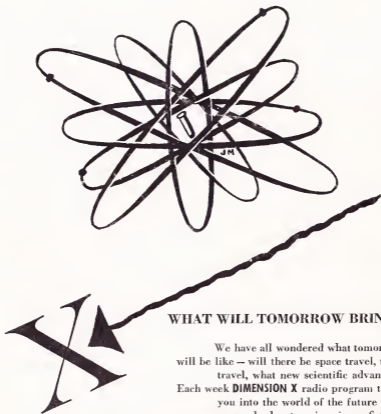
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